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VEGETABLE GROWING

BY

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Illustrated with 154 Engravings

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PREFACE.

It has been the aim of the author in preparing this work to consider the principles involved in vegetable production and at the same time to furnish sufficient detailed information to show definitely the connection between principles and practice. The book has been written primarily as a text, so arranged and developed as to meet the needs of collegiate undergraduate students in general courses in horticulture. In following out this plan the work under consideration treats:

First, the problems involved in the production of a supply of vegetables for the home table.

Second, the production on a field scale of those vegetable crops that are generally grown as such.

Since the work treats the subject from the stand-point of the production of vegetables for home use, it should prove of value to anyone interested in this phase of gardening. Likewise, it should be of equal value to farmers and others who are planning or who are engaged in the culture of those vegetables which are grown as field crops, such as tomato, sweet corn, peas, cabbage, cucumber, beans, sugar beets, and celery.

The classification of vegetables followed in this text is based upon seasonal requirements. The time necessary for maturing and the temperature requirements are given first consideration in this scheme, as these factors are of

greatest importance in growing a continuous supply of vegetables in the home garden.

Bulletins of the United States Department of Agriculture and State Experiment Stations have been consulted often in the preparation of this work, and many references are cited for which due credit is given at the proper places.

The author is indebted to the following for the use of illustrative materials to prepare the figures in this text:

The Country Gentleman and Henry A. Dreer for figures as credited in the text proper, Mr. C. E. Brehm for Figs. 42 and 144, J. C. Moninger Co. for Figs. 53, 54, and 55 and the accompanying specifications, Lord and Burnham for Figs. 56 and 57, the Purdue University Entomological Department for Figs. 80, 81, and 82, Columbia Planter Co. for Fig. 32, *Market Growers' Journal* for Figs. 4 and 147, and to the Horticultural Department of Purdue University for the use of negatives in preparing the remaining illustrations, a large part of which were taken by the writer.

The author is further indebted to Professor C. B. Sayre and Mr. W. E. Lommel for helpful suggestions, and especially so to Mr. O. G. Anderson for valuable assistance in correcting proof.

J. G. Boyle.

La Fayette, Indiana,
January, 1917.

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VEGETABLE GROWING.

CHAPTER I.

VEGETABLE GROWING.

Definition.—Vegetable growing, or olericulture, may be defined as the art of producing those crops which are commonly termed vegetables. A vegetable is considered to be the edible portion of an herbaceous plant which may be either an annual or a perennial. The distinction between a fruit and vegetable is sometimes slight and largely depends upon usage. In America the melon is often thought of as a vegetable and in Europe it is referred to as a fruit. The principal crops that are classed as vegetables are asparagus, rhubarb, pea, bean, beet, turnip, carrot, parsnip, rutabaga, potato, sweet potato, artichoke, lettuce, endive, parsley, spinach, celery, celeriac, cabbage, cauliflower, kohlrabi, broccoli, Brussels sprouts, chard, kale, onion, leek, garlic, bean, sweet corn, melon, cucumber, pumpkin, squash, tomato, pepper, eggplant and horseradish. Several of these are grown on large areas as field crops, and the potato is generally considered as such, although it may be grouped with vegetables.

Classification.—Olericulture, or vegetable growing, constitutes one of the main divisions of the field of horticulture.

The following outline shows this relationship and the arbitrary subdivisions that are made of the subject.

Horticulture.
- (*a*) Landscape gardening (planting the home grounds).
- (*b*) Arboriculture (forest tree culture).
- (*c*) Floriculture (growing flowers).
- (*d*) Pomology (fruit growing).
- (*e*) Olericulture (vegetable growing).
  - 1. Commercial gardening.
    - (1) Market gardening.
    - (2) Truck farming.
    - (3) Growing crops for the cannery.
    - (4) Vegetable forcing.
  - 2. Home gardening.
    - (1) City.
    - (2) Suburban.
    - (3) Farm.

1. *Commercial Gardening.*—Commercial gardening is the production of vegetables for profit.

Market gardening is the growing of an assortment of vegetables for the local market. A variety and succession of vegetables are grown in order to provide a continuous supply throughout the season. Quality and freshness are prime considerations. The products are hauled to market in the adjacent town or city and are sold there by the grower to the retailer or direct to the consumer.

Truck farming is applied to that branch of commercial vegetable growing in which the business is carried on at a distance from the market in a locality where the soil and climate are well adapted to crop production. The land is moderate in price and labor is generally abundant and cheap, making the cost of production very low. The crops are grown on a field scale, are transported to market by rail or boat and sold through brokers or commission firms. Some of the most prominent truck-farming regions are located in the Southern States where many vegetables are grown out of season and a good profit realized when they are placed on the Northern market.

Cannery crops, such as the tomato, sweet corn, and pea, are grown as field crops in those sections where canning and preserving establishments are located. These vegetables

are grown in rotation with the crops on the general farm and prove a profitable side line in many localities.

The forcing of vegetables under glass has received considerable attention in recent years. Cucumbers, tomatoes and lettuce are the main crops, the latter being the most important of the three. Radish, parsley and cauliflower are also grown to a limited extent. Vegetables are forced during the winter months, either in greenhouses or on a smaller scale in hot-beds. Forced vegetables compete on the market with those grown on truck farms in the South, as both mature at about the same time of the year.

FIG. 1.—The tomato is grown as a field crop for the cannery in those localities where preserving establishments are located. It is grown in rotation with general farm crops and has proven profitable in many sections.

2. *Home Gardening.*—Home gardening has for its aim the growing of an adequate supply of a desired assortment of vegetables to provide the home table. It is not conducted for the primary purpose of securing a financial return, although it must be recognized that a well-managed garden will materially reduce the cost of food. There are three classes of home gardens, the distinction being made with regard to their location and the amount of space available for each—city, suburban, and farm garden.

The city home garden varies in size from a square yard to a few square rods. On account of its small size only a limited quantity of a few kinds of vegetables can be grown. The amount of equipment is small and a very intensive system of cropping is practised.

The suburban home garden is moderate sized, being from a few square rods to one-half acre in extent. Land is less expensive and the lots larger in the suburbs of our cities, conditions which make it possible to have a vegetable garden

Fig. 2.—The forcing of vegetables under glass has received considerable attention in recent years. Lettuce is the most important forcing crop.

of greater size than is the case in the city proper. A larger assortment and greater amounts of vegetables are grown. Sufficient quantities are produced to supply the home table during the growing season. Some of the best-managed home gardens are found in the suburban districts. They serve as a means of recreation and exercise to their owners, who find themselves engaged during the day in the business world of the large cities. Having a love for outdoor life and the growing of plants, the garden becomes a hobby, and consequently receives all of the detailed attention that makes

for the abundant yields and high quality commonly found in the gardens of this class.

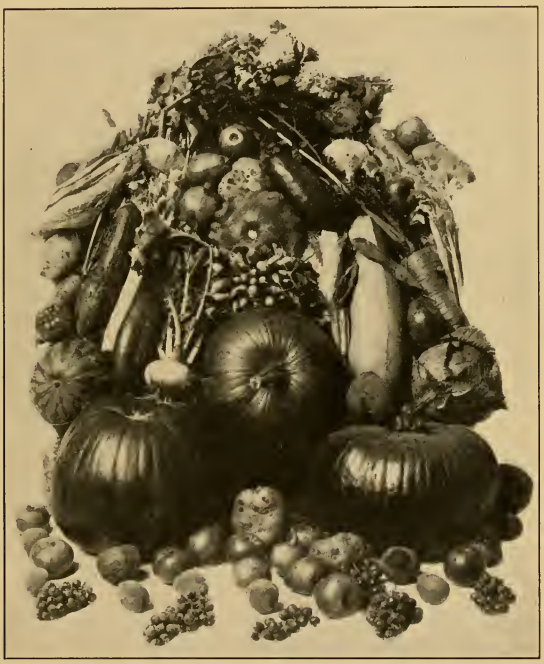

FIG. 3.—The home garden should produce an adequate supply of a desired assortment of vegetables to provide the home table. (The Country Gentleman.)

The farm garden generally contains a larger area than the suburban garden. In it may be grown some vegetables not found in the latter. Horse cultivation is practised which makes it necessary to have the rows far apart. This requires

considerable space and has made it necessary to set aside from one quarter to one acre of land for this purpose. In the farm garden is grown a sufficient amount of the desired vegetables for use in the fresh state and an additional supply of those that are preserved or stored for winter consumption.

History.—Vegetable growing was formerly included under the subject of gardening. Loudon defined gardening as the formation and culture by manual labor, of a scene more or less extended for various purposes of utility, ornament and recreation. He further stated that gardening had its origin in the supply of a primitive want; and as wants grew into desires and desires increased and became more luxurious and refined, its objects and its province extended. The field of gardening gradually divided itself into landscape gardening, which has to do with the growing and arranging of ornamental plants, and vegetable gardening, which consists in the production of kitchen garden vegetables.

The first herbage used by man for food purposes was the most succulent leaves or stalks that the plant life about him provided. Asparagus and cabbage were common in Greece from the earliest times, and still grow abundantly in that country. The Romans grew several varieties of melons and cucumbers, and were familiar with the forcing of the latter in pits protected by slabs of talc. Asparagus, onion, garlic, endive, lettuce, and parsley were also commonly found in the Roman gardens.

In comparison with the vegetables just mentioned, which have been subjected to the modifying influence of cultivation and selection for many centuries, there are others of recent introduction. Previous to 1850 the tomato was grown occasionally in American gardens as an ornamental plant, chiefly because of its highly colored fruits. It was considered by the majority of Americans to be detrimental to health and unfit for food. Shortly after the above date an enterprising Virginian began to use the fruits of the tomato for food purposes. Soon the unwarranted prejudice in regard to this vegetable was overcome and its use increased until at the present time about 800,000 acres are devoted annually in the United States to the production of this crop. During

this relatively short period the size and quality of the fruits of this plant have been greatly enhanced.

The farm garden in America dates back to colonial days. As soon as the first homes were located, garden seed brought from the mother country were planted. The garden had an important economic bearing upon the successes of the early colonists. It gave quick and substantial returns for the labor expended, and was considered a necessary adjunct to every home. In times past, when farmers were isolated and independent, the vegetable garden was a recognized institution, and the care and attention which it deserved were generally given it. The farmer of today is tending to become a specialist, and instead of growing nearly everything the family needs he devotes his time and attention to two or three crops. Consequently the farm garden does not occupy the position of importance that it did formerly, and on some farms it has become almost obsolete.

Commercial gardening had its beginning in America when the inhabitants began to collect in towns and cities. Growing vegetables for profit began in the districts adjacent to New York City, Boston, and Philadelphia. As the population of the cities increased and the demand for vegetables enlarged, more and more capital was invested in commercial vegetable growing, until at the present time large quantities of vegetables are grown about our cities, on truck farms, in greenhouses and on general farms for the cannery.

Present Status.—According to the thirteenth census of the United States, there were grown in 1909, 7,073,379 acres of vegetables valued at $418,110,154. Of this amount 3,668,855 acres produced potatoes valued at $166,423,910 and 641,255 acres produced sweet potatoes and yams valued at $35,429,176. This leaves for all other vegetables a remaining area of 2,763,269 acres with a crop value of $216,257,068 or an average annual value per acre of $78.26. The percentage of the total value of all farm crops for 1909 represented by vegetables was 7.6.

The same census reports that in 1909 small fruits were grown to a value of $29,974,481 and tree fruits to a value of

$140,867,347, making a total of $170,841,828 for all fruits produced in the United States as compared with $216,257,068 for vegetables. If potatoes and yams are included with vegetables the combined value exceeds that of all fruits almost three times.

Importance of the Home Garden.—The census for 1909 reports that there are 6,531,502 farms in the United States. Estimating that there is a garden spot of one-fourth acre on each farm, the total space devoted to garden purposes on farms will be 1,632,000 acres. Adding to this the acreage of gardens in the suburbs and cities will safely bring the total to 2,000,000 acres. With an average value per acre of $78 the total annual value of garden products consumed by the parties producing them will approximate $156,000,000.

The following data taken from the United States Department of Agriculture Farmer's Bulletin 635 shows the cost of maintaining each grown person for one year on the average farm:

Dairy products	$21.00
Pork	12.00
Poultry and eggs	12.00
Garden vegetables	10.00
Beef	6.00
Fruit	6.00
Wood and coal	13.00
Groceries	22.00
House rent	28.00
Labor	46.00
Total	$176.00

The total annual cost of maintaining each grown person as given in the above table is $176, of which only about 22 per cent. was paid out in cash. The remaining 78 per cent. was produced on the farm. Vegetables rank fourth with other home-grown food products, having a value of $10 per person. Of the vegetable products consumed, 96.1 per cent. were actually home grown.

These figures indicate the importance of the home garden as it actually exists at the present time. Although it is providing a considerable amount of food, there is still op-

portunity for improvement. A great number of gardens are poorly managed. Some are not a credit to the farms upon which they are found. It is not uncommon to find country places without any sort of garden. More intensive and improved methods will make it possible to double the present yields without increasing the acreage. With the adoption of better methods more and higher quality vegetables will be produced, and the tendency will be to use them in larger amounts on the table. Consequently, some of the more costly foods that must be purchased will be replaced by vegetables. This will mean better health and cheaper living.

The convenience of having fresh vegetables at hand cannot be overestimated and cannot be valued in dollars and cents. If one is near a market where vegetables can be purchased, they prove expensive and are only of average quality. Food experts have found that vegetables lose the quality which they may have possessed when gathered on account of the evaporation and chemical actions that take place *en route* to market. The highest quality in vegetables can be secured only when they are served immediately after gathering. This necessitates the growing of vegetables at home if that crispness and freshness that make for high quality are to be secured.

In Table I is given the chemical composition of the most important vegetables. From these figures it is readily seen that, as a class, vegetables are high in total water content and relatively low in what are considered valuable food nutrients. Yet they are much more valuable than these analyses indicate on account of the mineral salts they contain, the bulk they give to the diet, and the stimulating effect they have upon the appetite. Since the edible portion of most vegetables contains such a large percentage of water, but small quantities of plant food are removed from the soil by each crop, and consequently the land is not exhausted as quickly as when cereals are grown.

TABLE I.—CHEMICAL COMPOSITION OF VEGETABLES.[1]

Vegetable.	Water. Per cent.	Protein. Per cent.	Fat. Per cent.	Carbo-hydrates. Per cent.	Ash. Per cent.	Fuel value per pound in calories.
Asparagus, as purchased	94.0	1.8	0.2	3.3	0.7	105
Beans, dried as purchased	12.6	22.5	1.8	59.6	3.5	1605
Beans, Lima, fresh edible portion	68.5	7.1	0.7	22.0	1.7	570
Beans, string, edible portion	89.2	2.3	0.3	7.4	0.8	195
Beets, fresh, edible portion	87.5	1.6	0.1	9.7	1.1	215
Cabbage, edible portion	91.5	1.6	0.3	5.6	1.0	145
Carrots, fresh, edible portion	88.2	1.1	0.4	9.3	1.0	210
Cauliflower, as purchased	92.3	1.8	0.5	4.7	0.7	140
Celery, edible portion	94.5	1.1	0.1	3.3	1.0	85
Collards, edible portion	87.1	4.5	0.6	6.3	1.5	225
Corn, green edible portion	75.4	3.1	1.1	19.7	0.7	470
Cucumbers, edible portion	95.4	0.8	0.2	3.1	0.5	80
Dandelion greens as purchased	81.4	2.4	1.0	10.6	4.6	285
Egg plant, edible portion	92.9	1.2	0.3	5.1	0.5	130
Kohlrabi, edible portion	91.1	2.0	0.1	5.5	1.3	145
Leeks, edible portion	91.8	1.2	0.5	5.8	0.7	150
Lettuce, edible portion	94.7	1.2	0.3	2.9	0.9	90
Okra, edible portion	90.2	1.6	0.2	7.4	0.6	175
Onion, fresh, edible portion	87.6	1.6	0.3	9.9	0.6	225
Parsnips, edible portion	83.0	1.6	0.5	13.5	1.4	300
Peas, green, edible portion	74.6	7.0	0.5	16.9	1.0	465
Potatoes, Irish, edible portion	78.3	2.2	0.1	18.4	1.0	385
Potatoes, sweet, edible portion	69.0	1.8	0.7	27.4	1.1	570
Pumpkin, edible portion	93.1	1.0	0.1	5.2	0.6	120
Radish, edible portion	91.8	1.3	0.1	5.8	1.0	135
Rhubarb, edible portion	94.4	0.6	0.7	3.6	0.7	105
Rutabaga, edible portion	88.9	1.3	0.2	8.5	1.1	190
Spinach, fresh, as purchased	92.3	2.1	0.3	3.2	2.1	110
Squash, edible portion	88.3	1.4	0.5	9,0	0.8	215
Tomatoes, fresh, as purchased	94.3	0.9	0.4	3.9	0.5	105
Turnips, edible portion	89.6	1.3	0.2	8.1	0.8	185

[1] From Bulletin No. 28, Office of Experiment Stations, U. S. Department of Agriculture.

CHAPTER II.

LOCATING AND PLANNING THE GARDEN.

Site.—The garden serves as a supply department for the kitchen. From it are taken different sorts of vegetable foods as they become available and are needed. To be most convenient and useful the garden must of necessity be placed as near as possible to the kitchen. With the garden near by, it will receive better care and vegetables will be gathered and served more often.

Water supply and sunlight, although of secondary importance, are also to be considered. Hot-beds and cold frames require considerable amounts of water in late spring, and often it is desirable to irrigate the garden during periods of drouth. This makes it important not only to locate the garden near the kitchen, but also to place it at the same time near a copious supply of water, if it can be done.

A maximum amount of sunlight is always desirable for quick growth. A garden plot located adjacent to large trees will be shaded a portion of the day and will be robbed of plant food and moisture by the tree roots. Any objects, such as buildings, that will obstruct the light are to be avoided in choosing a site for the garden.

In locating the garden near the kitchen and a water supply, and distant from shade, it is well to consider the location chosen with reference to its relation to the home grounds. Although a well-kept garden is attractive in itself, yet at the same time, it does not add to the general appearance of the grounds when the latter is considered as a unit. The garden is bare and unattractive through the winter and must be sprayed, cultivated, and fertilized in summer. For these reasons it is preferable to locate the garden where it will not be seen prominently from the public highway, or

the approach to the dwelling. If the building arrangement will permit, place the garden at the rear of the dwelling and on the side opposite from that of the main entrance. Otherwise screen it from view by planting trees and shrubbery.

Exposure.—A southern or southeastern slope is most desirable, as here the soil dries out earlier in spring, making it possible to sow seed early, to secure a more rapid plant growth, and therefore earlier crops. A gentle slope is to be preferred to one that is steep, although it should be of sufficient length and grade to provide good air and water drainage. In prairie or other regions where strong prevailing winds are common, a wind-break will prove valuable. These are made by constructing a solid board fence, five or six feet in height, or better still, by planting a hedge, such as hemlock spruce, arbor vitæ, or privet. The wind-break is located on the windward side of the garden and far enough away to prevent shading and the absorption of plant food and moisture by the roots, if a hedge is used.

Soil.—The opportunity for the selection of a suitable soil is eliminated if the garden is located near the kitchen, as previously recommended. With a soil adjacent to the dwelling that is not satisfactory for vegetable production, it becomes necessary to change it both in regard to its fertility and texture.

Any type of soil that will produce farm crops may be used for the garden, but the best is a rich sandy loam free from stones and rubbish. A soil of a sandy nature gives best results on account of the rapidity with which it dries out and warms up in early spring, its power to make plant food quickly available, and the ease and quickness with which it may be worked after heavy showers. The undesirable characteristic of the sandy soil is its tendency to dry out rather quickly during periods of drouth.

If the soil is heavy, such as a clay or clay loam, and remains damp and cold until late spring, its texture can be greatly improved by the addition of lighter soils, such as sand or sandy loam. The latter can be hauled on to the garden during the winter months when the farm labor is idle and the garden unoccupied. A layer of sand four to six inches in

depth will be sufficient to lighten a heavy stiff soil. It is plowed under in the spring and worked thoroughly into the surface layer by cross disking and harrowing.

Other soil types, such as some of the prairie black loams that bake and crack after showers, will be greatly benefited by an application of sand or other light soils.

The addition of a sufficient quantity of sand to lighten the soil in the garden may appear to be an expensive operation, but if it is done at odd times and through a period of two or three years, the expense will not be noticeable. After the treatment has been given, it will not be necessary to repeat it for several years, as the imported soil remains almost permanently in the upper soil strata.

One farmer, whose land was heavy and remained cold until late spring, hauled 200 loads of sand onto his garden during the winter season. The following spring the sand was mixed carefully with the top soil, making the upper seven inches one-half sand. This treatment so changed the physical condition of the soil that the garden could be fitted three weeks earlier in spring and such crops as radish and lettuce could be gathered for table use four weeks sooner than was the case previous to the addition of the sand. Many localities are fortunate, at least from the stand-point of growing vegetables, in that they have a light soil. With this type only the fertility needs attention.

Value of a Plan.—The value of a plan for the garden cannot be estimated by the beginner until one has been made and followed for at least one season. Gardening is essentially an intensive system of crop production. Several of the vegetables grown mature in five to eight weeks. Three or four sorts are grown in a single row in one season. Small quantities of a large assortment are produced. The soil must be fertile and possess the proper physical condition. The cultural operations are varied and must be done at the right times. With such a variety of conditions to be encountered, success can be attained only by closely following a carefully thought-out plan.

The Plan.—The plan may be a mental one or drawn out on paper. The mental plan is the more common of the two,

and although it might be successful, practice has proven that it is very unreliable and only a makeshift at best. The paper plan is made on a heavy grade so that it will be permanent. A drawing board, T square, triangle, and rule are needed for making it accurate. The dimensions and direction of the plot to be used are determined and then outlined to scale on the drawing sheet, allowing an inch on the paper to represent a certain number of feet in the garden. The top of the drawing is placed toward the north.

The time for making the plan is in early winter, before seed is ordered for the hot-bed and garden. It should contain all detailed information, such as amounts, location, distances, companion and succession crops, planting dates, and varieties. After the plan is completed with pencil, it is inked to make it permanent, and preserved for use during the growing season and also to serve as a guide the succeeding winter when a new plan is being made. Notes can be entered on each plan as the season progresses, and the desired changes incorporated into the plan which follows until the garden conforms to the demands of the family that it is to supply.

The chief considerations in planning the garden are:

1. Sufficient supply to provide the family.
2. A succession and variety of crops through the season.
3. Ease and economy of management.
4. Maintenance of the fertility of the soil.

The Size.—The size of the garden will depend upon the type and fertility of the soil, the intensiveness of the methods practised, the climate, and the size and likes of the family for which it is to provide. The proper size can be determined only by trial and will probably vary for every home.

In the city the area of the garden is limited to a small tract, and generally is not of sufficient size to produce the desired amounts of vegetables. The present trend in the larger cities is to practice vacant lot gardening. In all cities of any size, there is a large area standing idle each year in the shape of unoccupied city lots, both in the old and new additions. Many of these are very unattractive on account of the wild plant growth that is allowed to grow

upon them. Because of this condition, owners have allowed the lots to be planted to garden vegetables. For those in the city who have little or no land at their disposal, these vacant spaces may afford an opportunity for gardening

FIG. 4.—A home hamper for shipping a variety of vegetables at regular intervals to customers in the city. By increasing the size of the home vegetable garden sufficient amounts can be grown to supply the home family and also another in a near-by city. The returns from those sold may be made to pay for the expense of the entire garden.

where otherwise there would be no means of growing a supply of vegetables for the home table. It has been estimated that the value of vegetables grown on vacant lots in the city of Philadelphia is around $75,000 per year.

The general practice in farming communities is to set aside too much land for the home garden. Better planning and more intensive methods will materially reduce the size of the average farm garden, consequently the labor cost, and at the same time the required amounts and kinds of vegetables can be produced. The size should be reduced to the minimum. As the land becomes more fertile through careful management, and more improved systems of culture are developed, the size may be made smaller or the yields greatly increased.

Professor Thomas Shaw reports in the *Minnesota Horticulturist* that a plot of ordinary land in Minnesota, one-nineteenth of an acre, or equal to the size of a plot 40 x 56 feet, kept a family of six mature persons abundantly supplied with vegetables all the year, with the exception of potatoes, celery, and cabbage. "In addition much was given away, more especially of the early varieties, and in many instances much was thrown away. In other words, the produce that could be thus obtained from an acre of land similarly situated would abundantly supply with nearly all the vegetables named 19 families, comprising in all 114 individuals."

The Shape.—The shape of the garden will depend somewhat upon its environment, but where conditions will permit, it is desirable to make it about twice as long as wide, with the long dimension extending north and south. This arrangement will lessen the amount of turning when cultivating and will permit a more even distribution of light to the plants.

The Kind and Amount of each Vegetable to Plant.—The kind and amount of each vegetable to plant depends upon the desires and size of the family to be supplied. There are several vegetables not commonly grown in the average garden, some of which are eggplant, endive, kohlrabi, Brussels sprouts, chard, kale, and asparagus. A taste for some vegetables must be acquired, and since they are prepared for eating in a variety of ways, only one of them may suit the beginner. The new or disliked kinds are worthy of a thorough trial before they are discarded permanently.

The amount of each kind to grow is determined by experience. A slightly larger amount may be planted than is needed to supply the family, in order to make allowances for unfavorable weather conditions.

Arrangement.—Arrangement is important in home garden work. Generally it is best to locate together vegetables that are grown in rows the same distance apart. Perennial vegetables are placed along one side of the garden, since the land they occupy is not plowed every season. Vegetables which require the same length of time to mature are placed in rows that are adjacent, and the quickly maturing sorts are grown on the side of the garden nearest the kitchen.

Distance.—The distance for planting vegetables in the home vegetable garden depends upon the kind of vegetable, the variety, the fertility of the soil, and the manner of cultivating. Trailing plants, such as cucumber, squash, and pumpkin are planted far apart, while onion, radish, and beet are planted close together. Some varieties of late cabbage maturing to a large size are set three or four inches farther apart than some early sorts. On fertile soils, vegetables can be planted closer together than if the soil possesses but an average amount of fertility. The distance between rows is necessarily greater with horse than with hand cultivation.

Companion Crops.—A companion crop is one that is grown in the row with some other vegetable. Companion crops are selected with reference to their size, method of growth, length of time required for maturity, and the kinds and amounts of plant food that they absorb from the soil. Radishes are planted with beets to mark the row and break the surface so that the beet seedlings, which are slower to germinate, may be able to push themselves through the surface. The radish matures and is removed before the beets are crowded. Pumpkins, cucumber, and squash are planted with sweet corn, as the latter grows erect and the cucurbits trail along the ground. Radish and lettuce are sometimes planted in the row between cabbage plants. They are mature and are harvested before the cabbage requires all of the space. The object in growing companion crops is

to decrease the size of the garden and thus reduce the labor cost. It is one method to be used in planning, whereby the cropping procedure can be considerably intensified. A rich soil and the removal of the secondary crop at the proper time are the requisites for success with companion crops.

FIG. 5.—Companion crops are grown in order to intensify garden methods. Early cabbage and head lettuce are set in the same row in early spring. The lettuce matures and is harvested before the cabbage requires all of the space.

Succession Crops.—Succession crops are those that are grown on the same land in one season, one occupying the land a portion of the season and another following it. In the list of succession crops will be included only those that mature quickly and occupy the land but a short period. Some of the combinations employed are early peas followed by beets or celery, radish followed by lettuce, and the lettuce by late turnips, early beets followed by endive, head lettuce or radish and onion sets followed by late cabbage. Two, three, and even four crops are sometimes grown in the same row at different intervals in one season. In selecting succession crops the kinds of plant food that each removes from the soil is of importance. It is not considered good

practice to allow root crops to follow root crops, and the same is true of vine crops, legumes, and other classes of vegetables that are closely related botanically. An example of the latter is the cabbage tribe to which belongs cabbage, cauliflower, Brussels sprouts, kohlrabi, and radish.

The term succession planting is applied to the sowing of a single vegetable three or four times in one season in order to have the vegetables for table use throughout a long period. Succession sowings, two to four weeks apart are made of radish, lettuce, pea, and sweet corn, three to five crops of each being grown in one season.

Planting Dates.—Planting dates for each vegetable should appear on the planting plan, in order that companion and succession crops may be provided for, and that the plan as a whole may be made more complete. One may not be able to sow seed on the exact date provided for on the plan if weather conditions are unfit; but as a rule, the planting can be accomplished either on the date planned or within the first or second day following it. With companion and succession crops, it is necessary to estimate the length of time required for maturity. This, of course, will vary according to the season, but even with this variation to account for, it can be done quite accurately after one becomes familiar with the type and fertility of the soil with which the work is being done.

Labor.—The labor needed to manage the garden should be adequately provided for in the general planning of the enterprise. In the city or suburban garden the labor resolves itself into a form of recreation and exercise and is done before and after office hours. In the country, the labor required for handling the garden would not in most instances be classed as recreation or needed exercise. It is real labor from the stand-point of the average farm family. For this reason it is highly desirable that arrangements be made to have the work done during the ten hours of the working day. Let it be considered a part of the farm labor, and not left to be done at odd times. The hired help, or the farm family, will seriously object to weeding the garden during the morning or evening hours, previous to or following a full day's

work. The garden requires but a small amount of labor to make it a success, but that much it must have, and at the proper time, or it will certainly prove a failure.

One family that has succeeded admirably with the home vegetable garden makes a practice of doing the planning in the winter at a time when each one that is interested may help. After the plan is complete, it is turned over to a member of the family who is made responsible for the project during the season. In like manner, another member is assigned the care of the lawn and shrubbery on the home grounds.

Rotation of Crops.—Rotation of crops in the garden is just as important as on the farm, and is done for the same reasons; that is, to conserve the fertility and supply of humus, and to hold in check insect, bacterial, and fungous pests.

A complete system of crop rotation in the garden will include the growing of a legume such as clover upon a portion of the area every season. By dividing the garden into three or four equal parts and moving the clover from one strip to another each year, the land will have a rest every third or fourth year as the case may be, and at the same time, the legume will increase the nitrogen and humus content of the soil. The individual crops may be rotated similarly. Those grouped together in rows the same distance apart as before recommended can be transferred as a group to a new location in the garden each succeeding year.

CHAPTER III.

THE SEED SUPPLY.

THE quality of seed secured for gardening purposes should be of the best, and only when such seed is planted can the garden be made the most successful. Vegetable seed are considered good when they are fresh, free from weed seed and inert matter, true to name, and possess strong vitality. Extra expense put in good seed will repay the purchaser many times in the yield and quality secured at harvesting time.

FIG. 6.—Purchasing vegetable seed in small packets at the corner grocery is convenient but not to be generally recommended. Get catalogs from reliable seed firms, select desirable varieties and order early in February to have seed on hand when wanted.

Purchasing.—The next step after completing the planting plan for the home garden is to purchase the required amounts

of seed. The usual procedure is to buy packets at the local grocery just before planting. This is a convenient method, but that is about all that can be said in its favor. It is true that some gardens would never be planted if it were not possible to secure seed in this way at the last moment; and with this type of gardener it serves a purpose. For those who plan the garden work in advance, it is recommended that seed be purchased from a reliable mail-order house. All prominent seed dealers publish an annual illustrated catalog which can be secured without charge by a request through the mail.

Varieties.—The varieties of each vegetable to select will depend largely upon their quality, the time required for maturity, and their yielding powers. Quality is of greatest importance in home vegetable growing, as the best is none too good for those who grow their own supply. Quickly maturing varieties must be chosen for early spring planting in order to have edible vegetables early in the season. Generally, varieties that mature quickly do not yield as abundantly as those that are termed main crop varieties; yet they are planted because they complete their growth in a much shorter time, and are ready for consumption early in the season when the demand for them is greatest.

The yields secured from different varieties of the same vegetable and also strains of the same variety secured from different sources may vary greatly. The Purdue University Agricultural Experiment Station Bulletin No. 165 reports that during the season of 1912, twelve samples of tomato seed of the Stone variety were secured from eight prominent seed houses located in widely separated sections of the United States and Canada. The twelve samples tested were grown in five States. Only four of the twelve lots were grown in the same section in which the seed houses were located. Seven were grown in Michigan, two in Illinois, and one each in Ohio, California, and New Jersey.

Plants from the California-grown seed produced the lowest yield, 13.5 tons per acre, and a carefully selected strain from a seed house in Illinois stood at the top with a yield of 17 tons per acre, a difference of 3.5 tons between two

equal-sized plots of like varieties of tomatoes grown under exactly the same conditions, the only difference being in the source of the seed.

A variation of eight days was also noted in the bearing season of the strains tested. The earliest bearer produced its first ripe tomatoes July 23, and the latest July 30. The earliest producers, however, did not give the highest yields as might be supposed. The 17-ton yield was secured from a strain which bore its first ripe fruit July 30. Many other minor variations were also found between the strains from the different sources, such as color and shape of fruit, character of vine growth, etc.

From these results it can be readily seen that the quality of Stone tomato seed furnished by different seed firms is quite variable. This is doubtless true of other varieties of tomatoes. Conditions which may be responsible for seed of varying quality are (1) care in selecting seed, (2) age of the seed when planted, (3) variation in the soil and climate in which the different samples of seed were grown and (4) the season in which the seed was grown.

The results of this test indicate that:

1. A large percentage of tomato seed now sold on the market is grown in localities especially adapted to its production.

2. Seed purchased from a certain seed house does not necessarily mean that it is grown in the same locality in which the house is located.

3. A poor sample of seed from a seed house does not indicate that all seed from that source is of like quality. The highest and one of the lowest yielding strains in this test came from the same seed firm.

4. The quality of tomato seed of the same variety handled by the seed trade varies rather widely in its yielding powers.

The same bulletin also reports for a three-year average a variation of from 11.51 tons of tomatoes to the acre for the I. X. L. variety, to 16.25 tons per acre of the Greater Baltimore. The Stone variety used in the former test yielded an average of 13.38 tons per acre.

The facts brought out by these tests indicate without a

doubt what may be expected of other vegetable seed. Just how to secure good seed is an unsolved problem. The suggestion previously given to buy direct from a reliable seed firm will aid to a certain extent. The price paid for vegetable seed at the present time does not permit the seedsman to grow the highest quality that he is capable of doing. Perhaps in the future the gardener may demand seed of better quality and be willing to pay for it.

Novelties.—Novelties are new varieties introduced by seedsmen from year to year, that may or may not prove of value. They are usually advertised quite extensively in seed catalogs and described in detail with descriptive terms of such a nature that the uninformed may buy them to the exclusion of all others. It has been said quite truthfully that the longer the description that follows a variety in a seed catalog, the less valuable the variety is likely to be. The old standard sorts are well known and need no advertising, and 95 to 98 per cent. of the varieties selected should be of this class. On the other hand, all of our standard varieties were novelties at one time, and it is only by testing the recent introductions that progress is made. Small quantities of some of the newer sorts may be tried out each season, that the grower may keep himself informed concerning those that are valuable.

Longevity.—Occasionally it may be desirable to plant old seed. Before this practice is engaged in the gardener will need to know how long different vegetable seed will remain viable. Longevity varies with the kind of vegetable, the variety, the season in which it was grown, methods of curing and storing, and perhaps other factors not determined. Experience and experimental tests have shown that the average life of different vegetable seed when its original strength has been good, is about as given in Table II.

Seed Testing.—In Table I is given the average life of different vegetable seed, but the only way to be certain that the supply secured will grow is to conduct a germination test. Some of our best seedsmen test their seed before it is placed on the market, yet this is done some time before it comes to the grower, and the only safe way is for the grower

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to do the testing himself, a short time previous to planting. Unfavorable climatic and soil conditions, as well as poor quality seed, are responsible for poor stands. The germination test will aid the grower in rightly placing the cause for poor results. Furthermore, the germination test will instruct him as to whether the seed is satisfactory for sowing and, if so, the amount that must be planted to insure a good stand. If large quantities of vegetable seed are purchased the amount of foreign matter and foreign seed, such as those of weeds, are also determined. Samples having above 2 per cent. of weed seed would not be desirable for planting. The seed should also be true to name, which can be determined only by growing the plants to maturity.

TABLE II.—GERMINATION AND LONGEVITY STANDARDS FOR VEGETABLE SEED WHEN PROPERLY CURED AND STORED.

Vegetable.	Per cent. Germination.	Longevity. Average years.
Asparagus	80 to 85	5
Bean	90 to 95	3
Beet[1]	150	6
Cabbage	90 to 95	5
Carrot	80 to 85	5
Cauliflower	80 to 85	5
Celery	60 to 65	8
Corn	85 to 90	2
Cucumber	85 to 90	10
Egg plant	75 to 80	6
Lettuce	85 to 90	5
Melon (musk)	85 to 90	5
Melon (water)	85 to 90	6
Okra	80 to 85	5
Onion	80 to 85	2
Parsley	70 to 75	3
Parsnip	70 to 75	2
Pea	90 to 95	3
Pepper	80 to 85	4
Pumpkin	85 to 90	4
Radish	90 to 95	5
Salsify	75 to 80	2
Spinach	80 to 85	5
Squash	85 to 90	6
Tomato	85 to 90	4
Turnip	90 to 95	5

[1] The beet "seed" is a fruit, usually containing more than one seed.

Various methods of testing seed are in use. One of the simplest is to count out from 25 to 100 seed, depending on the size, and place them between two moist blotters between two plates. The apparatus is placed in the living room and the blotters kept slightly moist for a period of six to ten days, when the test for most seed will be completed. The seed are examined daily and the rate and total amount of germination for each variety noted. A form similar to the following will prove satisfactory for this purpose:

Vegetable.	Variety.	No. seed.	Date started.	Daily per cent. germination.										Total. germination.
				1st	2d	3d	4th	5th	6th	7th	8th	9th	10th	

Fig. 7.—Garden seed may be tested by placing them between moist blotters between plates and keeping them at a living-room temperature. Keep the blotters moist and examine daily.

The rate of germination indicates the strength of the seed being tested. Vigorous radish seed will germinate in three to four days while that of the tomato and celery require a longer period. The average time required for the germination of some of our common vegetables is given in Table III.

The ideal way to test seed is to sow them in soil under conditions similar to those to which they will be subjected when planted in the open ground. The nearest approach to this will be to sow the counted samples in a bench in a greenhouse, or in flats in the hot-bed, and if neither of these are available, a small box filled with soil and kept in the living room will make a good germinator.

Under normal conditions some vegetable seed give a higher germination test than others. Germination percentages have been adopted by the United States Department of Agriculture to serve as a standard. Samples of seed that equal or surpass these standards are satisfactory for planting when considered from the stand-point of germination. These percentages are given in Table III.

TABLE III.—AVERAGE TIME REQUIRED FOR GERMINATION OF VEGETABLE SEED UNDER SATISFACTORY CONDITIONS.

Kind.	No. days.	Kind.	No. days.
Bean	5 to 10	Lettuce	6 to 8
Beet	7 to 10	Onion	7 to 10
Cabbage	5 to 10	Pea	6 to 10
Carrot	12 to 18	Parsnip	10 to 20
Cauliflower	5 to 10	Pepper	9 to 14
Celery	10 to 20	Radish	3 to 6
Corn	5 to 8	Salsify	7 to 12
Cucumber	6 to 10	Tomato	6 to 12
Endive	5 to 10	Turnip	4 to 8

Amount of Seed to Buy.—The amount of each kind of vegetable seed to buy for the garden is estimated quite accurately by first noting the space occupied on the garden plan, and then consulting Table IV. With this information, the order can be made out readily with the aid of a seedsman's catalog. Place the order early in January for immediate delivery, that the seed may be on hand for testing and making early plantings in the hot-bed. Such seed as potato, onion sets, and sweet potato, although ordered at the same time as the other supply, are not delivered until April first, as they are not planted until after that date, and are rather difficult to store.

TABLE IV.—QUANTITY OF SEED GENERALLY REQUIRED FOR PLANTING OR SOWING A GIVEN SPACE.

Vegetable.	Amount.	Space sown or planted	Amount required per acre.
Asparagus	1 oz.	50 feet of drill	4 to 5 pounds.
Beans (dwarf)	1 qt.	100 " "	2 bushels in drills.
Beans (pole, lima)	1 "	100 " "	
Beans (pole, wax)	1 "	150 " "	10 to 12 quarts.
Beet	1 oz.	50 " "	5 pounds in drills.
Cabbage	1 "	1500 plants	
Carrot	1 "	100 feet of drill	3 to 4 pounds in drills.
Cauliflower	1 "	1000 plants	
Celery	1 "	3000 "	
Corn	1 qt.	200 hills	8 to 10 quarts in hills.
Cress	1 oz.	16 square feet	
Cucumber	1 "	125 hills	2 pounds in hills.
Endive	1 "	100 feet of drill	
Egg plant	1 "	1000 plants	
Kohlrabi	1 "	3000 "	
Leek	1 "	100 feet of drill	20 pounds.
Lettuce	1 "	150 " "	
		1000 plants	
Martynia	1 "	100 hills	
Melon (musk)	1 "	60 "	2 to 3 pounds.
Melon (water)	1 "	30 "	4 to 5 pounds.
Okra	1 "	40 feet of drill	20 pounds.
Onion	1 "	100 " "	4 to 5 pounds.
Onion (sets)	1 qt.	50 " "	
Parsley	1 oz.	125 " "	
Parsnips	1 "	200 " "	5 to 6 pounds.
Peas	1 qt.	75 " "	2 bushels in drills.
Pepper	1 oz.	1000 plants	
Potato	..	.....	8 to 12 bushels.
Pumpkin	1 oz.	50 hills	3 to 4 pounds.
Radish	1 "	100 feet of drill	8 to 10 pounds in drills.
Salsify	1 "	70 " "	8 to 10 pounds.
Spinach	1 "	100 " "	10 pounds in drills.
Squash	1 "	50 hills	4 to 6 pounds.
Tomato	1 "	1500 plants	2 ounces.
Turnip	1 "	150 feet of drill	2 pounds in drills.

Home-grown Seed.—The home saving of seed for kitchen garden use is not considered a profitable practice. Vegetable seed production is a highly specialized business and requires the judgment of an expert to do the "roguing," selecting, harvesting, curing, and storing. In the home garden different varieties of the same vegetable are grown side by side, making

possible crossing and the production of impure strains. It has been mentioned that certain localities are better adapted to the production of vegetable seed than are others. Bean seed is grown in New York and Michigan, beet in California and New York, celery in California and France, and cauliflower in Denmark, Holland, and along Puget Sound. For these reasons, and because it is actually cheaper to buy than to grow the small quantities of each seed needed for the home garden, it is desirable to buy from a reliable firm that is making a specialty of seed production.

For those on the general farm, who are growing such crops as tomatoes on a field scale, and wish to improve a strain of a certain variety, the following procedure will prove satisfactory in a general way:

First Season.—Go into the field and select ten strong vigorous plants, each of which is bearing a large crop of the type of fruit desired. Save all the seed that can be gathered from each plant, keeping it in a separate package.

Second Season.—Set in ten rows ten plants grown from seed from each of the ten packages saved the year previous. The remainder of the plants grown from the seed are then used for the commercial planting. Collect seed for the breeding plot the following season by saving in separate packages the seed from each of the ten plants in the row which has the largest number of strong, vigorous plants, that are producing the desired type of fruit. Seed is saved from the remainder of the plot to provide a supply for field planting the ensuing year.

Third Season.—Conducted in the same manner as given for the second.

CHAPTER IV.

GARDEN TOOLS.

Kinds.—There is a variety of tools that may be secured to use in managing the garden. The kind and size will depend upon the size of the garden and the method followed in handling it. For a small area, a few light hand tools will prove sufficient, while for large areas, horse tools are necessary. Tools used for preparing land for field crops are available for garden work on the farm.

Garden Lines.—Garden lines are necessary for staking out the garden and locating the rows. One or two one-hundred foot lengths of line for this purpose will prove convenient and desirable. Lines made of hemp are considered to be most serviceable.

In order to handle a garden line advantageously, some form of reel should be provided. Various forms constructed of metal and wood are on the market. Those made of galvanized metal are more expensive, but are durable and easy to operate.

Stakes.—Stakes for garden purposes may be purchased in various sizes, either painted or unpainted. They may also be made at home, but if the material for making them must be purchased, it is cheaper to buy them already made. For staking tomatoes a 5-foot stake is generally used, while for labeling rows and varieties, an 8- to 12-inch label is of sufficient size.

The Spading Fork.—The spading fork is used for breaking the land in the small garden. It is similar to a pitchfork, and has four almost straight, stout prongs fastened to a short, stout handle. It is a convenient tool to have about the garden, even where horse tools are available.

Rakes.—Rakes are made in various widths, shapes, and having teeth of different lengths, shapes, and distances apart. The lengths of heads of garden rakes vary from 12 to $16\frac{3}{8}$ inches. The number of teeth from 12 to 16, and length of teeth from $2\frac{1}{2}$ to $2\frac{7}{8}$ inches. The rake head is made of malleable iron or steel, and the teeth are straight or curved. The gravel cast-iron rake, having short teeth and adapted to cleaning walks and drives, is not suitable for garden work.

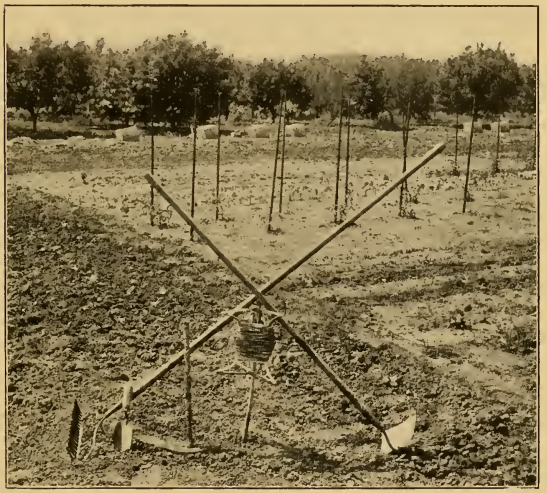

FIG. 8.—The garden reel, line, rake, hoe and trowel are indespensable for any kind of garden work.

One of the best types of garden rake that the writer has used has a head constructed of solid steel in the shape of a bow. The rake head is $15\frac{1}{2}$ inches long and has 16 curved teeth $2\frac{7}{8}$ inches in length. The rake head is fastened substantially by a heavy ferrule and cap to a polished and waxed all white ash handle 6 feet long.

Hoe.—The hoe is one of the most used tools in the home vegetable garden, and should be of the proper size, shape, and made of good materials. The blade may be secured in

Fig. 9.—Spading fork.

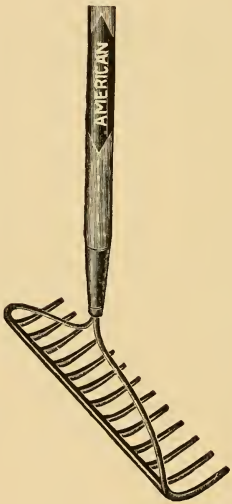

Fig. 10.—Steel bow garden rake.

Fig. 11.—Square-blade hoe.

Figs. 9 to 11.—(Courtesy of Henry A. Dreer, Philadelphia.)

different shapes and widths, as shown in Figs. 11 to 17, and are constructed of malleable iron or steel. Only the steel blades will hold an edge for any length of time. The

Fig. 12.—Weeding hoe and rake.

Fig. 13.—One-point garden hoe.

Fig. 14.—Two- and three-point garden hoes.
Figs. 12 to 14.—(Courtesy of Henry A. Dreer, Philadelphia.)

square blade, which is most commonly used, may be had in 6-, 7-, and 8-inch widths; the second width mentioned being generally preferred.

Fig. 15.—Scuffle hoe.

Fig. 16.—Warren hoe.

Fig. 17.—Half-moon hoe.

Figs. 15 to 17.—(Courtesy of Henry A. Dreer, Philadelphia.)

The weeding hoe and garden one-point and two-point hoes illustrated in Figs. 12, 13, and 14 are adapted to fine work where the rows are close together. The scuffle hoe is used for killing weeds and breaking the crust between the rows and makes a rapid and easily operated tool for covering large areas. The Warren type of hoe is an old style that is not common at the

present time, and was formerly used for covering corn and potato seed at planting time. The half-moon-shaped hoe is made in widths from 3 to 8 inches, the narrower widths being preferred by some for school garden work on account of their lightness and ease of handling.

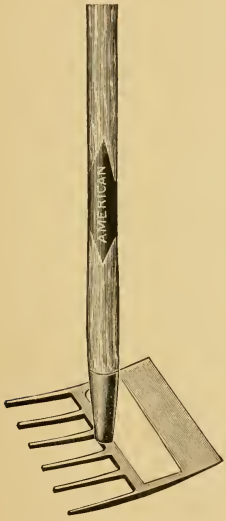

Fig. 18.—Combination rake and hoe.

Fig. 19.—Norcross garden cultivator.

Fig. 20.—Potato hoe.

Figs. 18 to 20.—(Courtesy of Henry A. Dreer, Philadelphia.)

One of the best square-bladed hoes on the market has a polished cast-steel blade, $6\frac{1}{2}$ inches wide, with a solid socket and heavy shank and ferrule. The handle is $4\frac{1}{3}$ feet long, polished and waxed all white ash. The same style is made with a 5-inch blade and a 4-foot handle to supply the demand for an extra light hoe.

Weeders, Trowels, and Dibbles.—Weeders, trowels, and dibbles represent the smallest tools used in garden work.

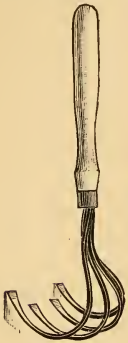

Fig. 21.—Yoder's hand weeder.

Fig. 22.—Eureka hand weeder.

Fig. 23.—Hazeltine hand weeder.

Fig. 24.—Lang's hand weeder.

Fig. 25.—Excelsior hand weeder.

Fig. 26.—Steel shank trowel.

Fig. 27.—English steel trowel.

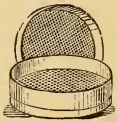

Fig. 28.—Soil sieve.

Figs. 21 to 28.—(Courtesy of Henry A. Dreer, Philadelphia.)

The hand weeders are made in different shapes and sizes as indicated in Figs. 21 to 25. They are used for doing hand work close to plants in the garden or hot-bed. The trowel and dibble are used for transplanting purposes. Two types of trowel are shown in Figs. 26 and 27.

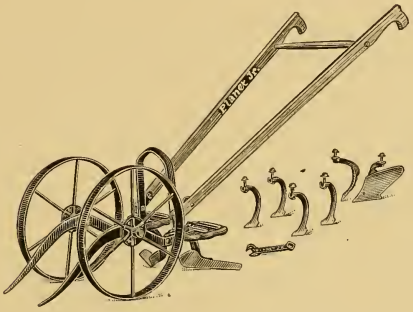

Fig. 29.—Double-wheel hoe. (Courtesy of Henry A. Dreer, Philadelphia.)

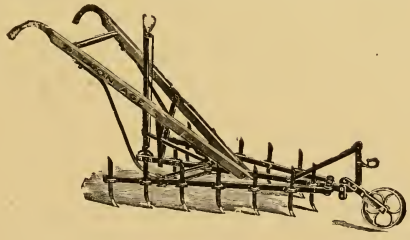

Fig. 30.—Combined harrow and cultivator. (Courtesy of Henry A. Dreer, Philadelphia.)

Cultivators.—Cultivators, both hand and horse power, are manufactured by a large number of firms, and the selection of these tools is largely a matter of personal preference. The hand cultivators, or wheel hoes, are constructed with one or two wheels. Several attachments

are made for the wheel hoes, so that they can be adjusted for different kinds of work. The two-wheeled hoes are preferred by many for garden work, as they are more easily guided and do better work than the one-wheeled tool. Rather high wheels and a high arch are desirable so that the cultivator will run easily and reach over high plants. In Fig. 29 is shown a good type of double-wheel hoe and the attachments that go with it. A common form of horse cultivator, satisfactory for the garden, is illustrated in Fig. 30. On the farm, where the garden is large and the rows far enough apart, the two-horse tools used for cultivating field crops can be employed.

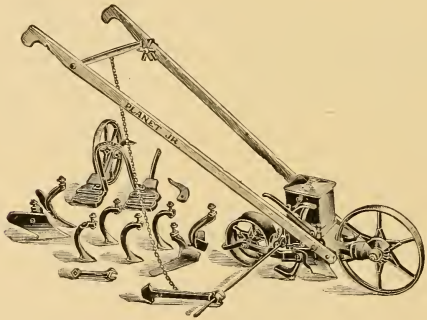

Fig. 31.—Combination hill and drill seeder and double-wheel hoe cultivator. (Courtesy of Henry A. Dreer, Philadelphia.)

Seed Drills.—Seed drills, although not well adapted to the needs of the small garden where the amounts of each vegetable seed sown are small and occupy but a portion of a row, are of value to the grower of truck crops and root crops, and where these are grown in quantity the seed drill becomes a necessity. Where these conditions prevail the seed drill used for sowing the other crops mentioned may also be made use of in sowing vegetable seed in the garden if the rows are long and the quantity sown rather large.

In the small garden where the rows are short and the amounts of seed sown limited, the sowing can be accomplished more quickly by hand. More time will be required for adjusting and cleaning the drill for each kind of seed planted than will be needed for hand planting.

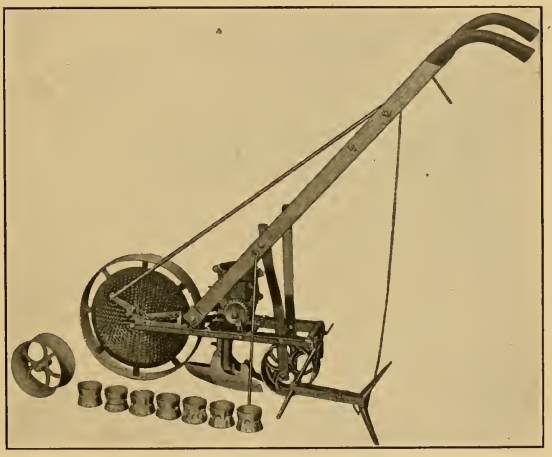

FIG. 32.—An excellent type of seeder and planter.

The types of seed drills on the market are as varied as are the tools made for cultivation. Some firms manufacture a combination hill and drill seeder and single-wheel hoe. The same combination is also made with the double-wheel hoe. When the tool is used for cultivating, the seeder is removed and *vice versa*, if seed are to be sown. The seeder and planter illustrated in Fig. 31 does accurate work, is well built throughout, and has many points in its favor.

Plows, Harrows.—Plows, harrows, and other tools that are required on the farm for the preparation of a seed bed for field crops will also be employed for fitting the garden soil

in early spring, whenever they are available. However, these tools and horse power are not essential for fitting the garden plot. Hand tools can be used with excellent results, although more time will be required.

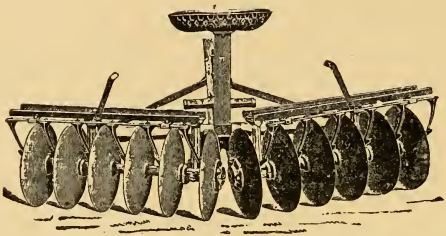

Fig. 33.—The disk harrow is a valuable implement for fitting the soil. (Courtesy of Henry A. Dreer, Philadelphia.)

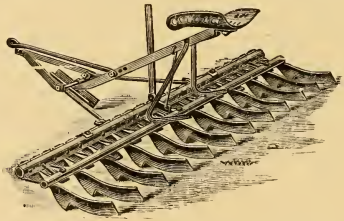

Fig. 34.—Acme pulverizing harrow. (Courtesy of Henry A. Dreer, Philadelphia.)

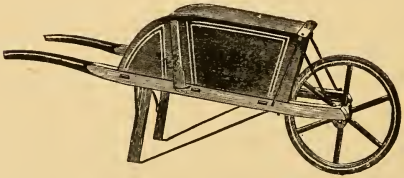

Fig. 35.—The wheelbarrow is a convenient tool in the small garden where horse power is not available. (Courtesy of Henry A. Dreer, Philadelphia.)

Thermometers.—Thermometers for determining the temperature in the operation of the hot-bed, are a necessity. The common form with the mercury bulb fastened to a thin piece of wood and protected by a metal covering, is

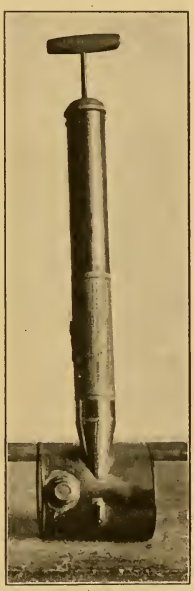

FIG. 36.—A hand brass atomizer holding 1 quart of spray material. It throws a fine mist-like spray and is of sufficient capacity for the average garden.

cheap and gives fair results, if hung so that sunlight does not strike the mercury. A self-registering thermometer is more desirable, but on account of its high cost is not recommended. If it is desired to take the temperature of the hot-bed soil, an especially constructed soil thermometer is made for this

purpose, which has the mercury tube placed inside a hollow wooden cylinder with an iron or brass tip on the end that is inserted into the soil.

Spraying Equipment.—Spraying equipment for controlling insects and fungi need be but simple and inexpensive. The hand brass atomizer holding one quart of spray material and throwing a fine mist-like spray, is of sufficient capacity for the average garden. If a larger outfit is wanted, a compressed-air sprayer of 3 to 5 gallons capacity may be secured,

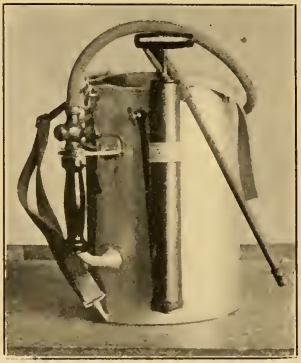

Fig. 37.—Compressed-air sprayer of 5 gallons capacity. The liquid is put under pressure by operating the air pump on the side of the metal tank which is so constructed as to be air-tight when closed.

and if a still larger one is desired, for both the home orchard and garden, a 50-gallon barrel pump outfit will be found most practicable. These three types of sprayers are illustrated in Figs. 36, 37, and 38.

If a nozzle is required for the outfit selected, the Vermorel, or disk types, are best suited to vegetable spraying. (See Figs. 40 and 41.)

Care of Tools.—The life of garden tools depends more upon their care when idle than the wear they are subjected to when in actual use. A good set of tools with proper care

and barring accidents, should last the owner many years. The first consideration is a convenient dry place for housing them when not in use. Convenient, so that the tools can be

Fig. 38.—Horizontal barrel pump outfit mounted on a low truck. The tank holds 50 gallons. This type may be used for spraying both garden and orchard.

gotten and put away quickly; and dry, to prevent rusting and corroding. Tools should never be left lying carelessly about the garden, and this applies mostly to the hoe and rake,

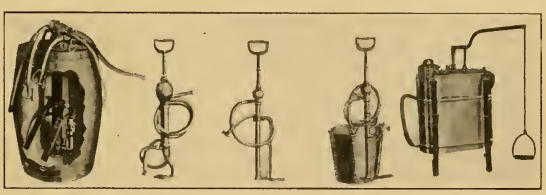

Fig. 39.—From left to right—barrel pump, three types of bucket pumps, and knapsack sprayer. (The Country Gentleman.)

which are often dropped where last used. A rusty rake and especially a rusty hoe are very unsatisfactory tools to work with, and it requires some time to wear the rust away. A

cloth dampened with coal oil or machine oil and wiped over the parts of the tools that come in contact with the soil, so as to remove all particles of earth, will keep garden tools in a satisfactory condition, provided they are stored in a dry place.

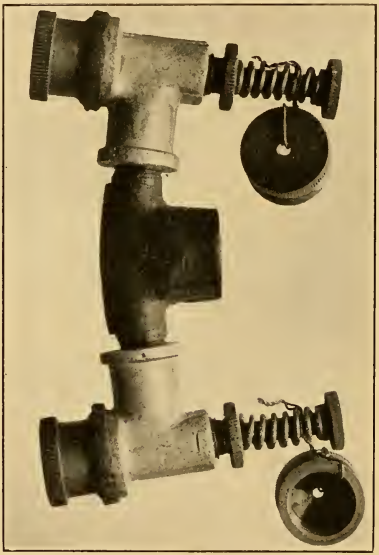

Fig. 40.—The Vermorel nozzle throws a mist spray. It is used singly or in pairs.

In the autumn, after the garden work is completed for the season, the tools should be given a general overhauling, repaired, smeared over with a heavy grease where likely to rust, and put under a substantial cover where they will be well protected during the winter months.

FIG. 41.—Straight and angle disk nozzles. The angle form is more desirable.

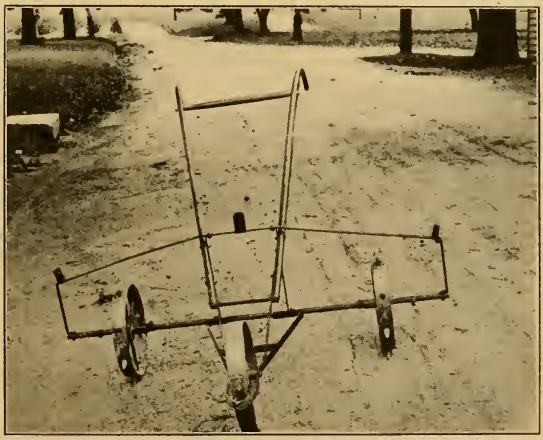

FIG. 42.—A convenient adjustable row marker for transplanted plants. The pegs on the wheels locate the places where the plants are to be set.

Selecting Garden Tools.—Several points to follow when selecting tools for the garden have been suggested. There is still the matter of quality or grade to buy. Money expended on cheap tools is a poor investment, and on the other hand, the highest priced ones are not required. A substantial tool at a fair price is to be preferred to either those that are cheap or high priced. Following are given the tools with prices that are generally considered desirable for managing the average-sized home vegetable garden, and the hot-bed connected with it. The price of each may vary somewhat in different sections and the kinds listed are suggestive and may be varied to suit the preferences of the gardener concerned.

TOOLS FOR OPERATING A MEDIUM-SIZED GARDEN.

1 100-foot garden line (hemp)	$ .70
1 garden reel (galvanized, single)	1.25
1 weeder (Lang's)	.25
1 garden trowel (steel)	.20
1 hot-bed soil thermometer (iron point)	1.00
or (brass point)	1.50
1 hoe (7-inch)	.55
1 spading fork	1.00
1 rake (15½-inch head, 16 teeth)	.70
1 cultivator (double-wheeled hoe)	5.00
1 spray syringe atomizer (brass)	1.00
1 galvanized watering can (12-quart)	.80

CHAPTER V.

CONSTRUCTION AND MANAGEMENT OF FORCING STRUCTURES.

In order to prolong the vegetable season, various methods of forcing have been practised by commercial gardeners for many years. Although inexpensive and not difficult of operation, equipment for forcing is not commonly owned by the grower who aims to produce a sufficient amount of vegetables to supply his own table. This is unfortunate, since some means of forcing will materially increase the efficiency of the home garden, and it is only when this equipment is provided and used that vegetables can be had out of their normal season. With the aid of a hot-bed all the plants required to set in the garden can be grown and in addition lettuce and radish can be matured in early spring a month earlier than they can be grown to edible size in the open. In the autumn these same crops can be had until Thanksgiving time by sowing seed in the bed (without heating material) about September 15, and protecting them when required, by putting on the sash. Rhubarb and asparagus are also advanced a month earlier than their normal season in spring by using the forcing box.

HOT-BEDS.

As the name implies, the hot-bed is an arrangement provided with artificial heat for forcing vegetables. It is used for maturing such crops as lettuce and radish early in the season before they can be grown in the open, and to start cabbage, cauliflower, and other plants to set in the garden when the weather has become sufficiently warm.

Construction.—In constructing a hot-bed, three parts must be provided—a cover, frame, and pit.

The Covers.—The covers consist of cloth or glass sash. Heavy muslin or light canvas that has been treated with linseed oil is used in the Southern States, but is not reliable in the North for hot-beds started in March. They are handled by tacking the cloth to frames 3 x 6 feet in size, or by rolling it after the method employed in the common window curtain. The only point in favor of the cloth is its cheapness. It will not keep out the cold, has a tendency to leak, shuts out some of the light, and is whipped about by the wind.

Glass sash, although more expensive at the start, are more satisfactory than cloth in every respect. The standard size for hot-bed sash is 3 x 6 feet, and they are made with single and double lights, the latter having two complete layers of glass about 1 inch apart, built into the frame. The double-light sash costs about one-third more than the single, and its advantage over the latter is that it allows a smaller amount of heat radiation during the night or on cloudy days, and eliminates the necessity of providing mats or extra covers which are required with the single-light sash for night protection during cold weather. For hot-bed work in March, the double-light sash should be provided on account of the extra warmth afforded by them. The single-light sash are lighter to handle, less costly, and permit a larger percentage of the heat from the sun's rays to enter the bed.

The size of the panes of glass used in standard sash is 10 x 12 inches and the grade should be strong and free from imperfections, such as spots and crystals.

The Frame.—The frame for the hot-bed may be constructed of grout, stone, brick, or wood. The wooden frame is the least expensive, and also the shortest lived, but if made of a good grade of cypress, or clear white pine, and kept well painted, it will last for several years. It has the advantage that its position can be changed from season to season, and it can be taken down and placed under cover during the part of the year that it is not in use.

Grout, stone, or brick are sometimes used for making the hot-bed frame, when it is located in a permanent position.

These materials are lasting, substantial, and are well recommended by those who have had experience with them.

The size of the frame depends upon the number of sash that are to be used. For a four-sash hot-bed, the size of the frame will be 6 x 12 feet. If another sash is added, the length of the frame will be extended 3 feet, the latter distance being the width of the sash.

FIG. 43.—A four-sash hot-bed frame supported at each corner by two by fours driven into the ground. The frame extends east and west and is set to slope toward the south. The pit is 2 feet deep, 6 feet wide and 12 feet long.

The shape of the frame is shown in Fig. 43, in which it will be noticed that one side is narrower than the other. The difference is 6 inches, which provides a slope of 1 inch to the foot when the sash are in place. This slope permits the sun's rays to enter at a less oblique angle, and allows water to pass away freely. The corners of the frame may be fastened with angle iron and bolts, as shown in Fig. 44. This method of fastening is substantial and gives opportunity to take the frame down and put it away in small space when not in use.

The Pit.—The pit varies in depth from 18 to 30 inches, and has the same length and width as the frame. The depth of the pit depends upon the season when the bed is started. If it is to be used in early March, the depth should be at least 2 feet to provide sufficient space to accommodate the necessary amount of heating material. Later in the season, 18 inches will be sufficient.

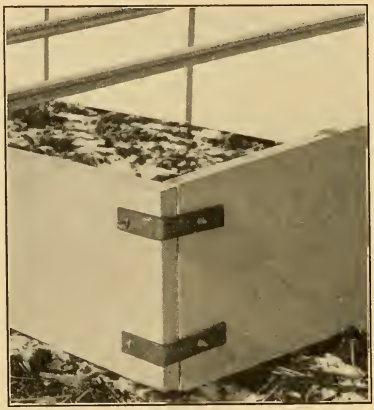

FIG. 44.—The corners of the hot-bed frame may be fastened together with angle irons and bolts. This method makes a substantial frame and gives opportunity to take it down and store it in a small space when not in use.

To avoid digging the pit when the ground is frozen, the work is done in the autumn and the pit filled with leaves or straw to keep out the frost. This precaution is taken to keep the sides and bottom of the pit from freezing. Otherwise a large amount of the first heat given off by the heating material will be required to thaw out the surrounding soil.

Location.—Locate the hot-bed near the garden, so that the plants will be close to the place where they are to be set, near a water supply, that the watering may be done easily

and cheaply, and near the dwelling, so that the ventilation may be done quickly. A slight southern exposure, if it can be chosen, is to be preferred as it is warmer. Avoid placing the hot-bed where it will be shaded at any time during the day by such objects as trees, fences, or buildings. The site selected should be naturally or artificially drained to prevent water from collecting in the pit during heavy showers. The latter condition can be partially prevented by locating the frame on a slightly elevated position, and banking earth around it, so that the land slopes gradually away from the bed. The frame always extends east and west with the lower side toward the south, to permit as much of the sunlight to enter through the sash as is possible.

Management.—The management consists in preparing the heating material and soil, sowing seed, watering, ventilating, and transplanting.

FIG. 45.—Forking over fermenting horse manure, previous to placing it in the hot-bed pit. This treatment is necessary in order to promote uniform heating. Some form of protection is required to prevent rains from destroying the heating properties of the manure.

The Heat.—The heat provided artificially in the hot-bed is secured by using fermenting horse manure, spent hops, or tan bark. The first mentioned is commonly used. It is collected fresh, free from litter, and mixed with about one-

third its bulk of straw or leaves, and then piled under cover to heat. After the pile has heated up thoroughly, it is forked over into another pile in such a manner that the manure on the exterior of the first will be on the interior of the second pile. After it has heated up well a second time, the manure is put in the hot-bed pit. To prevent settling, the heating material is put in layers 6 inches deep and each well tramped. The pit is filled up compactly to the height of the frame on the south side. Especial care is taken to keep the corners well filled and packed to prevent settling at these places after the soil has been added and the seed sown.

Truck growers sometimes construct fire hot-beds which are heated by two flues placed underneath the bed with a chimney at one end and the fire pit at the other. This method is not practicable for the home gardener, but the principle involved might be used in heating a hot-bed with heat from a steam or hot-water heating system employed for heating the dwelling.

Fig. 46.—After the second heating has been completed, the manuer is placed in the hot-bed pit. The corners should be kept well filled and thorough tramping should be practised to avoid settling. Soil is banked up around the outside of the frame to afford protection, and to provide surface drainage.

The Soil.—The soil, 6 inches in depth, is next placed in the hot-bed upon the fermenting manure. A rich garden loam is suitable for this purpose, although a properly prepared composted soil is to be preferred. The latter is made

by piling up alternate layers, 8 to 10 inches in depth, of blue grass sod and barnyard manure, six to eight months previous to the time that the soil is needed. During this period the sod and manure decay and the result is a rich friable soil in excellent physical condition for hot-bed work. If the composted material is coarse, it is put through a coarse screen to remove the rough or undecayed parts, and is then placed in the bed. The sash are next put on and the whole allowed to heat. The temperature may rise to 120° F. in a few days after which it will gradually recede. The temperature that may prevail inside and outside the bed are given in Table XII, p. 151. In order to have the hot-bed in condition for planting on a certain date, it must be fitted up several days in advance, to give time for the first violent heating to take place and subside.

Fig. 47.—Screening composted soil for use in the hot-bed. A composted soil is required for best results. It is prepared by piling up alternate layers, 6 inches in depth, of sod and manure. After rotting six to eight months the mixture is ready to use. Sand is added if the soil is too heavy.

Seed Sowing.—Seed sowing is begun when the temperature has dropped below 90° F. Previous to this time the excessive heat given off would kill the young seedlings after germination had taken place. The sowings are made in rows across the hot-bed, in flats or in dirt bands. The latter two are placed upon the soil in the bed after the seed has been sown in them.

Ventilation.—The ventilation of the hot-bed demands careful attention. Such plants as lettuce, radish, and those of the cabbage tribe, require a day temperature of about

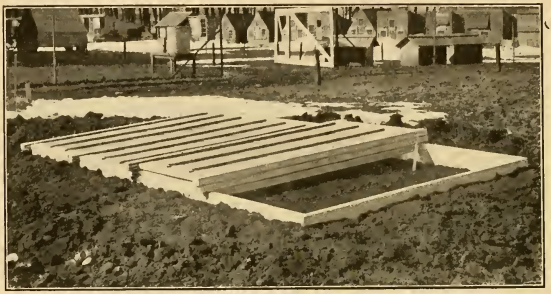

FIG. 48.—Following the placing of the fermenting manure in the hot-bed pit, a 6-inch layer of the prepared soil is added. The sash are then put on and the whole allowed to heat.

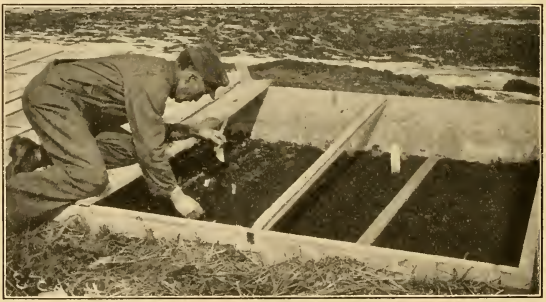

FIG. 49.—Seed are sown after the bed has heated up and the temperature dropped below 90° F. The rows extend across the bed and are 3 to 6 inches apart. The temperature is determined by the use of a hot-bed thermometer.

60° F. Tomato, eggplant, and pepper thrive best at a day temperature ranging from 80° to 85° F. At night the temperature for all plants runs 10° to 15° lower than the

day temperature. When both warm and cool crops are grown in the same bed, as is the case in home garden work, an average between the above temperatures may be maintained, or the bed can be divided with a light partition extended from the sash to a few inches below the hot-bed soil.

Ventilation is practised not only to control the temperature, but to admit fresh air to the growing plants. The change of air aids in keeping the bed dry, prevents damping off, and makes the plants grow stocky and strong. Only a very small amount of ventilation is given on cold days in March, while later in the season, when the weather is warm, the sash are removed entirely from the frame. Ventilation is accomplished in cool weather by raising the sash to a sufficient height at one end, or by sliding them down from the highest part of the frame. In manipulating the sash, they are raised on the side opposite from the direction the wind is blowing, so as to prevent cold draughts from striking the plants, as this condition will check the growth and induce disease. The temperature in the bed is determined by the use of a thermometer, which is placed so that the mercury bulb or tube is not in the direct sunlight. The most difficult time to ventilate the hot-bed is in March when the air is cold and there are alternate periods of bright sunshine and cloudiness. When the sun is shining, the temperature may rise to 90° or 100° F., and when clouds hide the sun, the temperature will drop 30° to 40° in a short time, if the bed is ventilated. It is with these conditions that the ventilation of the hot-bed must receive considerable attention. In cold weather, ventilation is begun in the late morning and continued until two or three o'clock. Many make a mistake in not closing down the sash early enough in the afternoon to conserve the heat for the night when there is no sunshine and the outside temperature drops several degrees.

Water.—Water is essential for the development of plants growing in the hot-bed. The amount to apply depends upon the temperature, humidity of the air, and the amount of sunshine. With average March weather one or two waterings per week will be sufficient. If the weather is dark and damp,

little or no water will be applied in order to prevent damping off and other fungous troubles. The watering is done in the forenoon when the temperature is rising so that the added moisture will be warmed during the warm part of the day and the foliage of the plants be dried off by night. In applying water, thorough applications that reach well down to the roots of the plants are given. Frequent applications in small quantities keep the foliage and surface soil moist, providing ideal conditions for the development of fungous diseases. Furthermore, the light application of water does not reach the root systems. For these reasons the light, frequent waterings are to be entirely avoided.

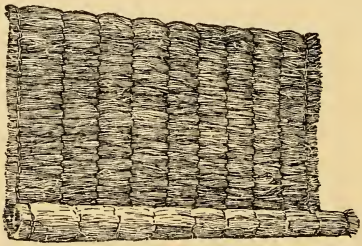

FIG. 50.—Straw mats are placed over the hot-bed to give protection during cold nights. If double-glazed sash are used, mats are not required. (Courtesy of Henry A. Dreer, Philadelphia.)

In winter weather it is sometimes desirable to take the chill from the water by placing it over a fire. A 3- to 5-gallon watering can with a long neck and fine rose sprinkler is the best outfit for watering the home garden hot-bed. In April and May a hose is suitable and more convenient, if water under pressure is available.

Cultivation.—Cultivation is as beneficial in the hot-bed as in the garden, and is given for the same reasons. The soil is worked with a scratcher, or with a narrow combination hoe and rake. Cultivations are given often enough to keep a crust from forming and weeds from growing.

COLD FRAMES.

Construction.—The construction of the cold frame is similar to that of the hot-bed, with the exception that no pit is dug and no heating material used. The frame is placed on the ground and the only heat obtained is from the sun, which is conserved at night by means of covers such as sash, cloth, and mats. The cold frame is used principally in the North to harden off plants after they have been started in the hot-bed or greenhouse, and when used for this purpose, cloth is sometimes substituted for the glass sash. Where the winters are mild, the cold frame may be substituted for the hot-bed, but in the Northern States this is impossible when the bed is to be planted as early as March first.

Fig. 51.—Crop of radishes started in a cold frame in September to provide a supply for late autumn. Lettuce may be grown in a like manner.

Management.—The management of the cold frame is the same as that already given for the hot-bed. Proper temperatures are maintained and water applied as needed. The cold frame is not required for the home garden where the hot-bed is provided. The latter can be made to serve as a cold frame for hardening off plants after the heat of the manure has been spent.

FORCING BOXES.

Construction.—The forcing box is a miniature cold frame, and is employed to force rhubarb and asparagus in the garden where the plants are permanently located, and to protect plants from frost after being set in the garden. Forcing boxes are made of wood and metal and in different sizes. If used for rhubarb forcing, they should be 16 inches square, 18 inches high on the back side, and 14 inches high

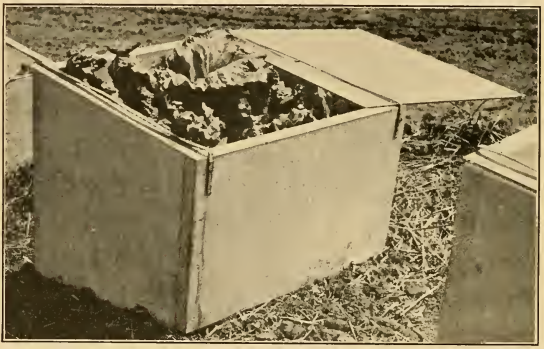

Fig. 52.—Rhubarb forced two or three weeks ahead of its normal season by means of the forcing box. The box is 16 inches square with the back side 16 inches and the front side 12 inches high.

on the other. A pane of glass is placed across the top and held in position by two bands of strap iron, as shown in Fig. 52. Boxes with smaller dimensions will be large enough for protecting plants, such as melon and tomato, from frost.

Commercial firms are manufacturing forcing boxes out of galvanized metal, which are well adapted to protect plants from frost in early spring. One type of these has a pane of glass covering one side of the frame, and is recommended for protecting tomato plants when set early in the season. White pine or cypress are the most desirable kinds of lumber

from which to construct those made of wood; and, when home-made they are inexpensive.

Management.—Forcing is accomplished by placing a forcing box over each plant at a time in February when the frost is out of the ground. After the boxes are in place, the rows are covered with a layer of manure of sufficient depth, if possible, to prevent the ground from freezing again. The heat from the fermenting manure and the sunlight that passes through the pane of glass at the top, raises the temperature about the roots sufficiently to start them into growth. Ventilation is obtained when needed by adjusting the pane of glass. No watering is required.

When used to protect tender plants from frost, a forcing box is simply placed over each plant and left until the weather has become milder.

GREENHOUSE OR CONSERVATORY.

The modern home builder is beginning to include in his plans a greenhouse or conservatory. With the advent of modern methods of heating, such as steam or hot water, a small conservatory for growing flowers, vegetables out of season, and starting plants to set in the garden can be built at a reasonable cost. A small house 6 x 10, or 8 x 12 feet, will be of ample size to supply the needs of the home garden, and at the same time be used for growing flowers and foliage plants. The heat and water can be provided cheaply from the house furnace and water system. One of the important reasons for constructing a conservatory is that it can be substituted for the hot-bed, making the latter entirely unnecessary. Those having had experience with both will agree that the conservatory has many points of superiority over the hot-bed, and that where conditions permit, it is to be preferred.

Type.—The type to build depends largely upon the amount of money that the builder wishes to put into the house. The built-in lean-to is the most economical to construct, cheapest to heat, and cheapest to operate, and for general purposes is very satisfactory. Manufacturers of greenhouse

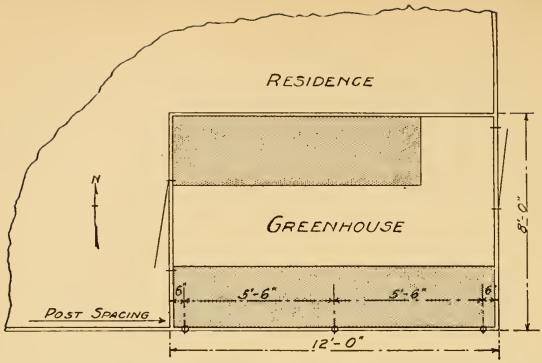

FIG. 53.—Floor plan of an 8 x 12 foot lean-to greenhouse in connection with a dwelling. The shaded portions represent the benches. The water and heat are secured from the dwelling.

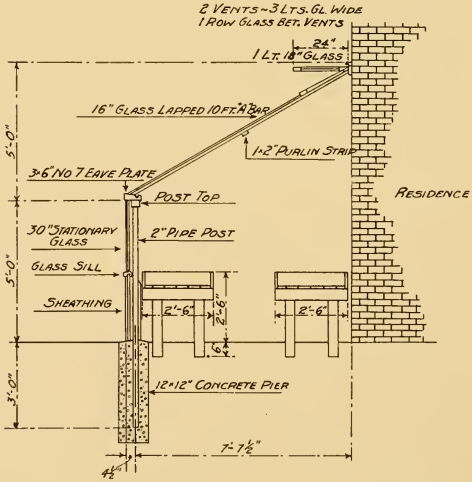

FIG. 54.—Cross-section drawing of the greenhouse illustrated in Fig. 53. The estimated cost of this greenhouse is $60.65.

materials are prepared to furnish estimates and working drawings and cut materials all ready for houses of any dimension. With a blue print to follow, which is furnished by the manufacturer, a carpenter can put up the small greenhouse without difficulty.

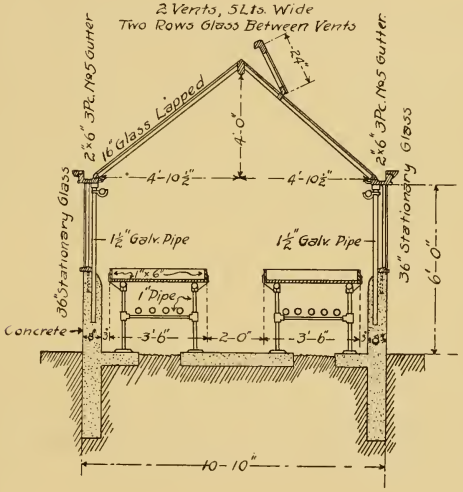

FIG. 55.—Cross-section drawing of an even span greenhouse 10 x 20 feet in size. The estimated cost of this house, including a heating plant, is $251.50.

Location.—The lean-to type is placed on the south side of the dwelling, where it will not be shaded. The side of the dwelling serves as a north wall to the greenhouse. Strong prevailing winds are to be avoided if possible. If the greenhouse is to be built by itself, place it where it will be convenient, in the direct sunlight, and protected from strong winds.

Management.—In general, the small greenhouse is operated the same as the hot-bed. The artificial heat is provided by a steam or hot-water heater instead of by fermenting horse manure. Watering and ventilating are handled as previously given for the hot-bed.

Cost.—Following is given an itemized list with costs of the materials required for building a lean-to greenhouse in connection with a dwelling. The greenhouse is 8 x 12 feet, and located at the southeastern corner of the building. The heat and water are taken from the dwelling, making these cost items unnecessary. Working plans for this greenhouse are shown in Figs. 53 and 54.

Semi-iron Construction.

Material for the construction of one lean-to, 8 x 12, one glass gable, one single door, 16″ glass lapped, and 5′0″ walls.

WOODWORK.

1 run 12′0″, 3 x 6″, No. 7 eave plate.
1 run 12′0″, 1½ x 5″, ridge and cap for lean-to.
1 run 12′0″, 1 x 2″, purlin strip.
20 lineal feet glass sill for side and ends.
1 single sash door, 3′6″ x 6′1⅜″, 4 lights and frame.
40 lineal feet gable end bars, pattern No. 10.
2 pieces 10′0″ gable rafters.
8 pieces 10′0″ roof sash bars, pattern No. 2.
2 ventilators, 3 lights glass wide x 24″ down x 1⅜″ thick.
2 pieces seat strips, gained for 3 lights 16″ glass.
4 pieces weather strips, cut for 24″ vents.
8 side bars, pattern No. 9 cut for 30″ glass.
2 corner bars.

VENTILATING APPARATUS.

2 complete hand lifters.

PIPE POSTS AND FITTINGS FOR WALLS.

3 pieces 2″ black pipe cut 8′0″, pinned.
3 pieces 2″ black cast-iron post tops.
6 pieces 2″ blocking clamps.

HINGES FOR ROOF VENTS.

2 pairs plain hinges.

HARDWARE FOR DOORS.

1½ pairs hinges.
1 set latches.

NAILS.

All necessary galvanized nails not including benches.

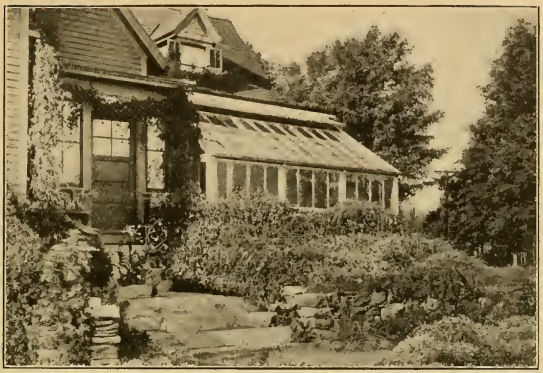

FIG. 56.—A lean-to greenhouse in connection with a dwelling. The heat and water are taken from the house, thus eliminating these cost items. This is a very desirable substitute for the hot-bed.

FIG. 57.—A small greenhouse plant of sufficient size to start vegetables for setting in the garden, to force vegetables out of season and to grow flowers and house plants: A separate heating plant, located in the service building at the rear, is provided for this house.

PUTTY.

25 pounds greenhouse putty.

GLAZING POINTS.

1 pound J. C. M. galvanized glazing points.

SHEATHING.

60 feet 1 x 8 common D. and M.
60 feet common cypress drop siding.

PAINT.

1 gallon paint for two-coat work.

BENCHES.

(If home-made, cost will be somewhat reduced.)
Lumber to be best common cypress not cut to fit.
1 2′6″ x 10′0″ bench.
1 2′6″ x 12′0″ bench.
2 x 4″ legs and cross-pieces.
1 x 6″ bottoms.
1 x 8″ face boards surfaced one side.

Total for all materials specified	$43.65
4 boxes 16 x 18″ D. S. A. glass at $4.25	17.00
Total	$60.65

In Fig. 55 is shown a cross-section of a greenhouse 10 x 20 feet in size. The estimated cost of materials for building this house with semi-iron construction is $125.

The necessary heating equipment for this house is as follows:

1 hot-water boiler of sufficient capacity to maintain a temperature of 60° F. when the temperature at night is zero outside	$39.00
Expansion tank, pipe and all necessary fittings .	87.50
Total cost heating plant	$126.50

The cost of the greenhouse plus the cost of the heating plant makes a grand total of $251.50.

CHAPTER VI.

METHODS OF GROWING AND HANDLING SEEDLING PLANTS.

The normal method of growing crops is to sow the seed in the soil and allow the plants to come up and grow to maturity where the seed germinate. In garden practice, where intensive methods are followed, many vegetables are started in the hot-bed or seed-bed and later transferred to the garden where they mature their crop. The reasons for growing plants in this manner are:

1. To secure earliness with such plants as cabbage and cauliflower.

2. To grow profitable crops of such plants as tomato and pepper, which do not have a sufficiently long season in which to mature a satisfactory crop in our climate when started in the garden.

3. To make better use of the land by growing two crops in succession which would not be possible because of too short a season if the seedling plants were not grown elsewhere.

4. Vegetable plants can be grown and cared for in a seed-bed at much less expense for the first four or five weeks than if planted in the garden where they would occupy a much larger area.

Transplanting.—All plants started in a seed-bed or hot-bed must of necessity be transplanted to the garden, if they are to produce a crop. The best time to transplant is in the evening or on cloudy days, when the weather is moist. When removing the young plants from the seed-bed it is best to take a ball of earth with the root system and keep it intact until the plant is set in the ground. This prevents the loss of a considerable portion of the roots and consequently the plant is not seriously checked in its growth. Other

requisites to success in transplanting are: stocky, well-hardened plants, a moist and well-firmed soil about the roots, and a thorough watering just before the plants are taken from the bed. Young plants of cabbage, celery, and cauliflower are often shortened at the top when transplanted to prevent too great transpiration of moisture.

Transplanting is done by hand with the aid of a dibble or spade in the garden, while under field conditions a two-horse transplanter is used by some farmers.

Hardening Off Plants.—This expression is used by gardeners to denote the checking of the growth of plants in the hot-bed so that the tissues become firm and solid. It is accomplished by subjecting the plants to cool temperatures, or sometimes by withholding moisture. The hardening off process is begun about two weeks before the plants are to be set in the open, and is accomplished by reducing the temperature gradually until the temperature of the hot-bed or cold frame is the same as that outside. The plants thus treated are accustomed to outside conditions and are not checked to any extent when set. Such plants as cabbage and cauliflower are capable of withstanding frost, and tender plants like the tomato are able to stand cooler temperatures, if both are properly hardened off.

Flats.—These are made of durable lumber with dimensions about 15 x 20 x 3 inches outside measurements. The bottom is made of three boards with cracks one-fourth inch wide left between them to provide good drainage. The flat is filled with a rich composted soil and used as a container in which to prick off seedling plants. These are transplanted into the flats at a distance of 1 x 1 to 2 x 2 inches, and allowed to grow in them until the weather is favorable, when the flat with the plants is taken to the garden and the setting done. Flats are used on account of the convenience they afford in doing the work and in shifting the plants in the hot-bed or cold frame when conditions become crowded.

Dirt Bands.—The dirt band is an inexpensive contrivance consisting of a band of paper with slits cut in the end. When it is to be used it is bent into the shape of a cylinder and the

two ends caught together by means of the two slits. Two sizes, 3 inches and 4 inches in depth and diameter respectively, are made by manufacturers.

The bands are handled by placing them close together in the hot-bed on two or three layers of old paper and then filling them with soil. The bands have no bottoms and the old paper is used under them to keep the roots in the enclosed soil. In each band are planted two or three seeds of the vegetable desired, and when the resulting plants are about

Fig. 58.—Flats containing recently transplanted tomato plants. The dimension of each flat is 3 x 15 x 20 inches outside measurements which is of sufficient size to accommodate about 80 seedling plants.

2 inches tall, they are thinned down to the one best plant. When the time for setting arrives, the plant, dirt band and soil intact are taken to the garden and set where desired. The roots are not disturbed at any time in their growth and the plant begins growing immediately, since it has received no check whatever.

On account of the large amount of space required for handling the dirt bands, as just suggested, it is a practice with some to sow the seed in rows or broadcast in the hot-bed,

and prick off the young seedlings when two or three weeks old, putting one plant in each band, where it remains until set.

Flower Pots.—Made of clay or stiff paper are employed for growing young plants similar to the way just given for dirt bands. They may be used on a small scale, but are too expensive where large numbers of plants are grown.

FIG. 59.—The dirt band is an inexpensive contrivance consisting of a band of paper with slits cut in the end. It is bent into the shape of a cylinder and the two ends caught together by means of the two slits. Each band is filled with soil and placed over two or three thicknesses of paper to keep the roots of the growing plant within the enclosed space.

The Best Method.—Gardeners are growing young plants in a variety of ways in the greenhouse, hot-bed, or cold frame. There are many general opinions held in common by gardeners of considerable experience concerning the best methods of starting seedling plants. In order to test out the different methods of starting and handling plants in forcing structures, the Horticultural Department of the Purdue University Agricultural Experiment Station conducted a series of experiments along this line through a period of three years. The results of this work conducted with the tomato have been taken directly from Purdue Bulletin No. 165, and follow herewith.

The Stone variety was used in this test and the plants were started and handled in five ways, as follows:

Plot 1.—The seed was sown in a seed-bed in the open ground as soon as weather conditions permitted in the spring. The plants were grown in rows 18 inches apart and at a distance of 2 inches apart in the row. When of sufficient size they were taken from the seed-bed and set directly into the field.

Plot 2.—The seed was sown in a hot-bed in rows 6 inches apart across the bed and the plants thinned to 2 inches apart in the row when 1 inch in height. At setting time they were removed from the bed and taken directly to the field.

FIG. 60.—Size and condition of tomato plants at the time of the first transplanting. The plants at the right show the method of removing them with soil attached to the roots. Those at the left show the size of the root system at this stage of their development

Plot 3.—The seed was sown in a hot-bed in rows 6 inches apart across the bed and seedling plants transplanted into flats when the first true leaves began to form. When set in the field a ball of earth was lifted with each root system and taken with the plant to the place of setting so as to disturb the roots as little as possible (see Figs. 61 and 62).

Plot 4.—The plants were handled the same as those in plot 3 with the exception that they were transplanted twice into flats before setting in the field (see Figs. 63 and 64).

Plot 5.—The seed was sown in veneer dirt bands placed in the hot-bed. Three or four seeds were sown in each and

later thinned to one plant. The plants including the dirt and bands were taken to the field and set (see Fig. 66).

The dates of sowing the seed, transplanting, and setting in the field for each of the three seasons are given in Table V. It will be noted in this table that the seed for the different plots were sown each season on the same date except those in plot 1, where the plants were started in a seed-bed in the open ground. It was necessary to sow the seed much later

Fig. 61.—Size and condition of well-grown tomato plants at time of setting in the field that were previously transplanted once into flats.

here because of unfavorable conditions in the open ground during March and early April which were controlled in the hot-bed. As soon as the soil could be fitted the seed was sown in the seed-bed, which occurred on April 11 in 1910 and April 20 in 1911 and 1912. These late sowings made it necessary to set the plants in the field later in 1910 and 1911 than those that were hot-bed grown on account of the plants being too small at an earlier date.

TABLE V.—GIVING THE DATES OF SOWING SEED, TRANSPLANTING AND SETTING IN THE FIELD OF TOMATO PLANTS STARTED AND HANDLED IN DIFFERENT WAYS.

Plot No.	How started.	Dates of sowing seed.			Dates of transplanting.			Dates of setting in field.		
		1910.	1911.	1912.	1910.	1911.	1912.	1910.	1911.	1912.
1	Plants grown in seed-bed	April 11	April 20	April 20	.....	.....	.....	June 9	May 27	May 23
2	Plants grown in hot-bed	March 21	March 25	March 23	.....	.....	.....	May 21	May 18	May 23
3	Plants hot-bed grown, transplanted once	March 21	March 25	March 23	April 8	April 20	April 10	May 21	May 18	May 23
4	Plants hot-bed grown, transplanted twice	March 21	March 25	March 23	April 8 April 29	April 15 April 29	April 10 April 30	May 21	May 18	May 23
5	Plants hot-bed grown in dirt bands[1]	.....	March 25	March 23	.....	.....	.....	.....	May 18	May 23

[1] Conducted only during 1911 and 1912.

In Table VI are given the results of these tests. The yields and cost of growing plants have been calculated upon the basis of 1742 plants per acre which number can be grown on this area with the plants set 5 x 5 feet. For plot 1 a seed-bed containing 440 square feet was required for growing 1742 plants. For 2 and 5 six hot-bed sash, for 5 eight, and for 3

Fig. 62.—Tomato plants removed from flats for setting with soil attached to the roots to prevent them from wilting and being severely checked.

and 4 three hot-bed sash each were used for growing sufficient plants to set one acre. The value of the crops produced was estimated at $10 per ton, which is the customary price paid in many tomato-growing sections of the country. An itemized statement covering the cost per acre for growing the young plants for each method follows:

TABLE VI.—GIVING THE PICKING SEASON, TONS YIELD PER ACRE OF FIRST, SECOND AND TOTAL FRUITS, AVERAGE YIELD PER ACRE, COST OF GROWING PLANTS PER ACRE AND THE VALUE OF THE AVERAGE TOTAL YIELD PER ACRE, LESS THE COST OF GROWING TOMATO PLANTS IN FIVE WAYS DURING 1910, 1911 AND 1912.

Plot No.	Method of starting plants.	Picking season.			Tons yield per acre.									Average total yield.	Cost growing plants per acre.	Value average total yield per acre, less cost of growing plants.
		1910.	1911.	1912.	1910.			1911.			1912.					
					1sts	2ds	Total.	1sts	2ds	Total.	1sts	2ds	Total.			
1	Grown in seed-bed in the open ground	Aug. 22 to Oct. 1	Aug. 14 to Oct. 19	Aug. 14 to Sept. 19	2.81	.41	3.22	3.77	.96	4.73	6.92	.92	7.84	5.26	$1.30	$51.30
2	Hot-bed grown—not transplanted	July 30 to Oct. 1	July 20 to Oct. 19	July 30 to Sept. 19	4.94	1.01	5.95	9.72	.78	10.5	12.27	1.73	14.0	10.15	4.90	96.60
3	Hot-bed grown—transplanted once into flats	July 23 to Oct. 1	July 23 to Oct. 19	July 28 to Sept. 19	6.95	1.43	8.38	9.73	.8	10.53	10.93	1.06	11.99	10.3	4.95	98.05
4	Hot-bed grown—transplanted twice into flats	July 30 to Oct. 1	July 15 to Oct. 19	July 31 to Sept. 19	8.7	1.19	9.89	10.16	.72	10.88	10.21	1.5	11.71	10.82	6.70	101.50
5	Hot-bed grown—seed sown in dirt bands—not transplanted	.....	July 14 to Oct. 19	July 18 to Sept. 19	..	..	....	13.36	1.19	14.55	13.65	1.65	15.3	14.92	8.80	140.40

PLOT 1.—SEED-BED PLANTS.

Cost of labor	$1.30

PLOT 2.—HOT-BED PLANTS NOT TRANSPLANTED.

Cost of labor	$1.30
Cost of hot-bed frame and sash per season (6 sash)	3.60
Total	$4.90

PLOT 3.—HOT-BED PLANTS TRANSPLANTED ONCE INTO FLATS.

Cost of labor	$ .65
Cost of frame and sash per season (3 sash)	1.80
Cost of flats per season (24 flats)	.75
Cost of transplanting	1.75
Total	$4.95

PLOT 4.—HOT-BED PLANTS TRANSPLANTED TWICE INTO FLATS.

Cost of labor	$ .65
Cost of frame and sash per season (3 sash)	1.80
Cost of flats per season (24 flats)	.75
Cost of two transplantings	3.50
Total	$6.70

PLOT 5.—HOT-BED PLANTS GROWN IN DIRT BANDS.

Cost of labor	$1.75
Cost of sash and frame per season (8 sash)	4.80
Cost of dirt bands (4 in.)	2.25
Total	$8.80

In considering the data included in Table VI the first important point noticed is the record made by the seed-bed plants. The only item in their favor is the low cost of growing. As regards the annual yields and average yields they are much inferior to those produced by any of the other methods. The date of first picking is also fifteen to twenty days later than with those started in the hot-bed. With an average yield of 5.26 tons of tomatoes to the acre costing $1.30 for plant growing, the value of the crop less the cost of growing is $51.30, or about half the value of the crops produced from the hot-bed-grown plants. The showing made by this plot during the three years places this method

of starting plants out of the question with the up-to-date tomato grower who is desirous of securing maximum yields.

When the results secured from the other four methods employed are compared the differences are not nearly so large. In plots 2, 3, and 4 the first pickings were made approximately on the same dates during each season. In plot 5 it is noted that the plants as a whole bore a few days earlier than in plots 2, 3 and 4.

FIG. 63.—Size and condition of tomato plants at the time of the second transplanting into flats. They are removed with soil attached to the roots, as shown by the plant at the left.

From the stand-point of average yields plots 2, 3 and 4 vary but little, and after the cost of growing has been deducted from the value of the crop secured from each the result is a return per acre of $96.50 for plot 2, $98.05 for plot 3, and $101.50 for plot 4. The average yields from plot 5 in which the plants were grown in dirt bands and not transplanted exceeds by four tons that produced by any of the other four plots. At the same time the cost of growing the plants does not greatly exceed that for the other hot-bed-grown plants. This part of the work was carried on only during two seasons and the comparison with the other methods is not quite exact as given in the last column in Table VI, yet the increase

in yield is so great that there can be little doubt of its being the most profitable method employed in these tests for starting seedling tomato plants. In fact, if only the results of the two seasons 1911 and 1912 are considered, it will be seen that the comparison still remains quite the same and that method No. 5 is still by far the most profitable one.

Fig. 64.—Size and condition of tomato plants at the time of setting in the field that were previously transplanted twice into flats.

The reason for the greater yield secured from plot 5 is because no roots are lost when the plants are set. By growing them in the bands each plant is fenced off by itself and when the roots reach the sides of the band they turn backward into the soil and are compelled to feed in their own allotted space. Then when they are set no roots are cut or broken off and a new root system does not have to be produced before the plant can begin to develop. With all of the fine root hairs present the tomato plant grown in the band is not checked in the least by the change and continues its growth even more rapidly than in its formerly confined space. With

all of the transplanted plants a large portion of the most valuable part of the root system is torn away when the location of the plant is changed. This necessitates the growing of a part of a new root system before the plant can carry on its functions to the fullest extent.

FIG. 65.—A convenient carrier for transferring plants from flats to the places where they are to be set.

The results from plots 2, 3 and 4 show that where a plant is removed from the soil in which the seed was sown, it is desirable to transplant it once or twice temporarily in flats before setting in the field. This tends to bunch the roots and accustom the plant to the change brought about when reset. There is another great advantage in transplanting into flats as compared with growing the plants entirely in the hot-bed and that is the ease and safety with which they can be removed to the field at setting time. This is accomplished by loading the flats with the plants in them onto a wagon bed and hauling them to the field and distributing along the rows. In this way they can be allowed to stand several hours with no indications of wilting. When ready to set, the tomato plants are removed with soil attached to the roots, placed in baskets and dropped carefully in the places where

they are to be planted. An old case knife or butcher knife will be found useful for cutting the soil into blocks which are removed with each individual plant.

FIG. 66.—Size and condition of plants at time of setting in the field that were previously grown in veneer dirt bands. Plants grown in this manner give highest yields.

All of the plants grown in the five plots were set by hand. A transplanting machine could not have been used except with those grown in plot 1 in which the plants were started in the seed-bed. The hot-bed-grown plants were removed with the soil attached to the roots, and could not have been handled in this condition by the type of transplanters now in use without removing the balls of earth that were attached to the root system. The keeping of the root system intact without injury or drying was largely responsible for the

greater yields produced by the hot-bed plants. The comparison and results reported here apply only to hand-set plants and will not hold true if the soil should be removed from the roots and the plants handled as they generally are with the horse transplanter.

Results of Coöperative Experiments.

During the season of 1911 the three tests made on plots 2, 3 and 4 given above were duplicated on a field scale, the plots being one acre in extent. The comparative yields corresponded closely with those obtained at the Experiment Station and in the order mentioned. There was a new factor entering in, however, where the plants were handled on a large scale and that was the loss of plants when set in the field. On the acre plot set to plants that were hot-bed grown but not transplanted, 85 plants died and had to be reset. Where hot-bed plants transplanted once into flats were used, 18 plants were reset and with those hot-bed grown transplanted twice 16 plants were reset to each acre.

In another field test, with less favorable weather conditions at setting time, 600 plants failed to grow in the plot set with hot-bed plants not transplanted into flats, while but 100 plants died on the plot set with hot-bed plants transplanted once into flats.

When the loss due to setting in the field as just given is considered in connection with Table VI, the results given for plot 2 are even of lower standing when compared with those for plots 3 and 4.

Summary.

The results secured in this series of tests indicated that these methods of starting tomato plants under the conditions which existed will be placed in the following order as regards their efficiency in increasing the profits from tomatoes grown on a field scale for canning purposes:

1. Plants hot-bed grown, seed sown in dirt bands and plants not transplanted before setting in field.

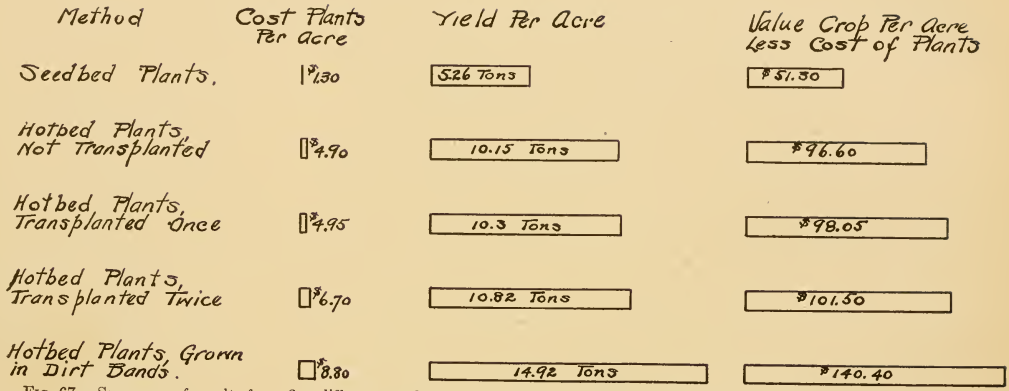

FIG. 67.—Summary of results from five different methods of growing and handling plants. The chart compares the methods from the stand-point of cost of growing the plants, yield and value of crop less cost of plants. Crop value is taken as $10.00 per ton for ripe, sound tomatoes.

2. Plants hot-bed grown, transplanted twice into flats before setting in the field.

3. Plants hot-bed grown, transplanted once into flats before setting in the field.

4. Plants hot-bed grown, not transplanted into flats.

5. Plants grown in a seed-bed in the open ground.

From these results it is evident that the best method for the home gardener to practice is to start and grow the seedling plants of tomato in the dirt band where the roots are disturbed at no time during their growth. The experience of plant growers has shown that the same practice is the best with other vegetables started in the hot-bed. For the home grower of vegetables the growing of plants in dirt bands, as previously described, is to be highly recommended.

CHAPTER VII.

FITTING THE SOIL.

Breaking.—Fall plowing is a general practice with the commercial gardener, and is often desirable with the home garden where the soil is heavy and remains damp and cold until late spring. The advantages of fall plowing are: that it improves the physical condition of the soil, causes vegetable matter plowed under to be in a more advanced state of decay, destroys insects hibernating in the soil, and is accomplished at a time when work is not pressing. Spring plowing is practised with sandy loam soils that have been in vegetables the year previous, and is in more general use for the home vegetable garden where the area is limited to a small tract. With fall plowing it is generally desirable to replow or disk the soil thoroughly in the spring just before planting. Ridging, after fall plowing, is done to expose as much of the soil, as possible to the wind and sunshine of early spring, in order to warm up and dry it out for early planting.

Deep plowing is a requisite of good garden practice. Eight inches, 10 inches, or even more, is desirable where the soil is deep. If a hard pan or unproductive soil, such as gravel, is encountered a few inches below the surface, the plow should be set to throw up about an inch of the poorer soil each season until the desired depth is reached. Such vegetables as the root crops can be grown successfully only in a deep, free working soil, and for the rapid development of all vegetables a deep seed-bed is a requisite.

The condition of the land at the time it is plowed is important. Oftentimes the garden is plowed and worked in early spring when too wet. This causes puddling, an unsatisfactory condition of the soil particles which may not be remedied for several seasons. The soil is considered to be in a

condition for working when a small amount taken into the hand and pressed into a ball will retain its shape and at the same time will crumble readily with pressure of the fingers without sticking.

If the spading fork is used to turn the land, it should be handled so that each forkful of earth is inverted and the soil turned clean to an even depth.

FIG. 68.—A deep seed-bed should be prepared for growing garden vegetables. Fall plowing is preferred with a soil that remains damp and cold until late spring. Light soils may be plowed in early spring.

Disking.—The disk is one of our best tools for fitting the soil. It completes to a great extent the work begun by the plow, and to obtain best results, is used on the land both before and after breaking. This tool is of especial value for cutting up sod that has been plowed under, and for mixing manure and fertilizers with the garden soil. In disking or harrowing, either tool is first drawn parallel with the direction of the furrows and then worked across them.

Harrowing.—Following the disk, the spring-tooth harrow is used to work the soil until in proper tilth. If available, a spike-tooth harrow is next used to level the land for planting. Otherwise the garden rake is employed for finishing the seed-bed.

The harrowing should be done the same day as the plowing and disking to prevent the soil from drying out and

becoming cloddy. In preparing a seed-bed, too much care can hardly be exercised in getting the soil into the best condition as regards tilth and moisture. Small vegetable seed will germinate evenly and grow rapidly only when they are in complete contact with a fine moist soil. A bed in which there are small lumps and dry spots will give a poor and uneven stand. The proper condition is secured when the soil is without clods and is moist entirely to the surface. A plank drag or planker, as it is sometimes called, is used when

Fig. 69.—The planker is used to finish the fitting of the seed-bed. It crushes all of the small lumps of soil and leaves the surface smooth for sowing.

the soil is loose and when the gardener has not succeeded in keeping the soil from becoming lumpy. The planker and harrow are used alternately until the soil is in suitable condition, the former being used last to leave the soil surface level for seed sowing.

Drainage.—In locating the garden plot near the kitchen, it may be necessary to place it on wet land that needs artificial drainage. Two or three lines of 4-inch tile laid below the frost line with a fall of 3 or 4 inches per hundred

feet will remove all excess moisture. If there is no convenient outlet one can be provided by digging a cesspool and emptying the laterals into it. The drainage system can also be used for subirrigation purposes by stopping the tile at the lower end and admitting water from a supply system at the upper end.

Fertilizing.—Large and early yields and high quality demand a rich soil. Some soils contain more plant food than others, but there are none that cannot be improved for vegetable growing by the addition of some form of fertilizer. As a general rule vegetable crops require a much larger amount of available plant food for their best development than general farm crops.

Fertility is added to the soil by the use of animal manures, commercial fertilizers, and green manures.

Animal Manures.—Animal manures, when available, are the most satisfactory for home garden work. They add plant food and organic matter, from which originate certain organic acids. These acids are especially valuable in that they act upon the food in the soil, changing it into an available condition. Animal manures are applied in the fresh state, partially decayed, and well decayed. Well-rotted manure contains the largest amount of available foods for the immediate use of plants, and is the most valuable for garden soils. Manure that has been leached, or overheated, has lost a large part of its nitrogen and other food elements, and is of much less value than manure that has been properly handled.

Well-rotted manure is applied in the spring just before plowing, or in some cases, is put on after breaking and worked into the soil. Partially decayed manure is applied in the autumn as a top dressing, and plowed under at that season of the year. The amount to use varies from 40 to 100 tons per acre, depending upon the fertility of the land, and the rottenness of the manure. These amounts may seem excessive to those accustomed to general farming, but they are not too high, as any truck gardener or home gardener will testify, who has been engaged in this line of work for any length of time. The manure spreader is the best tool for

distributing manure on the land, but any method that will put it on evenly and finely divided will give good results.

Animal manures are the cheapest and best form of fertilizer to use in connection with the home garden. Only small amounts of commercial fertilizers will prove practicable, as long as a sufficient quantity of well-rotted manure can be secured.

FIG. 70.—Well-rotted animal manures are especially desirable for fertilizing the garden; apply just before the land is plowed, at the rate of about 50 tons per acre if thoroughly rotted.

Commercial Fertilizers.—Commercial fertilizers are sold on the market in a concentrated form. They are put up in different combinations and strengths, supposedly adapted to the needs of different crops on different soils. A complete fertilizer is one containing the three essential plant-food elements: nitrogen, phosphoric acid, and potash. An incomplete fertilizer contains one or two of the above elements, but not all three. In most states commercial fertilizers are sold under a guaranteed analysis tag, furnished by the State chemist, whose office it is to test all brands of fertilizers sold under his jurisdiction, and to determine if they are up to the standards claimed for them by the manufacturer. If the gardener desires he may purchase the required elements in their original form, and mix them him-

self in the right proportions. Home-mixed chemical fertilizers are cheaper and just as efficient as those bought already mixed.

Nitrogen is of much importance in vegetable production. It stimulates the development of the leaves, stems, and roots, and tends to delay maturity. This element is used as a fertilizer for lettuce, cabbage, spinach, and other foliage plants, where a large amount of herbage is wanted. Nitrogen is present in manure in the form of ammonia, and is purchased as a commercial fertilizer in the form of nitrate of soda, dried blood, and sulphate of ammonia. Nitrogen, generally in the form of nitrate of soda, is often applied alone to young vegetable crops. It is dissolved in water and applied, or it is placed in small trenches along the side of vegetable rows, and covered. Nitrate of soda is concentrated, immediately available, and is applied to young plants to stimulate growth. The chemical is not allowed to come in direct contact with plant roots, as it is injurious. All three forms of nitrogenous fertilizers previously mentioned are used singly or in combination in the mixing of complete fertilizers.

Phosphoric acid is closely associated with the growth of stems, roots, and especially so with the seed. On account of the part that it plays in seed production, it is used largely as a fertilizer in the production of peas, beans, and other crops in which seed is the part desired. This element is purchased on the market in the form of rock phosphate and bone meal. In whichever form secured, a large part of the phosphorus should be in the available state.

Potash tends to hasten maturity, and is of importance in the development of stems and seed. It is familiar to everyone in the form of unleached hardwood ashes, and is sold on the market in muriate and sulphate of potash and kainit. Of the sulphate and muriate of potash, the former is generally preferred for vegetable crops. Wood ashes and kainit are low-grade forms of potash. The muriate and sulphate are high grades and much more expensive.

Lime is generally present in sufficient quantities in most soils, but if the soil becomes sour, an application of air-slaked lime will remedy this condition, and make the land more productive.

Commercial fertilizers are generally applied broadcast after the land is plowed, and then thoroughly incorporated with the soil by disking and harrowing. Sometimes they are drilled in by means of a fertilizer attachment on the drill, at the time the seed are sown, or are applied as top dressings when the crop is growing, and then worked into the soil. With plants in hills, such as tomatoes, commercial fertilizer may be applied around the hill by hand to give the plants a good start. From 800 to 1400 pounds per acre of a complete fertilizer may be added profitably as a general application each season.

Green Manures.—Green manures are secured by growing and plowing under such crops as rye, clover, alfalfa, soy beans, cow peas, and vetch. They are sown after the regular crops have been harvested, and allowed to grow until the next season, when it becomes necessary to plow the land for the succeeding crop. The decaying plants add plant food and provide organic acids, which are required for making plant food available in the soil. This is the cheapest method of supplying fertility, but is not well adapted to the intensive methods that are necessarily followed in the home garden.

Where space is available, one-third to one-fourth of the garden area may be sown to clover each year, and left to grow until the following season, when it is plowed under and another section sown to clover. This arrangement provides a clover crop in rotation every third or fourth year.

CHAPTER VIII.

SEED SOWING.

Staking Out the Garden.—After the garden has been properly fitted, it is next laid out for planting. This may be accomplished in a variety of ways. The following method is a good one. First set the four corner stakes with a right angle at each corner. Then with the aid of the planting plan and tape, set stakes in line with the two corner stakes at both ends of each row in the garden. All of these stakes should be driven in firmly and left during the first half of the season to mark the rows. It is also desirable to place the number of the row on each end stake as represented on the garden plan. If each row is to be divided into quarters, or halves, for planting with different kinds of vegetables, stakes should be set at the proper distances along the sides of the garden to serve as guides for making an accurate division of the rows.

Soil Conditions.—The success following seed sowing depends upon the physical condition, moisture, and temperature of the soil. The physical condition has already been discussed under a previous chapter.

Moisture.—Moisture is a requisite to the germination of seed, and must be present in the soil if they are to grow. Water absorption by the seed is the first phase of germination. In order for vegetable seed to germinate rapidly, the soil must be fine, in a moist condition, and in complete contact with the seed coats. The latter condition is obtained by firming the soil well after planting. Following germination, moisture is still required to keep the young plant in a thriving condition, and is conserved for this purpose by means of cultivation.

Wet soils prevent germination by excluding the oxygen of the air, and if this condition prevails for some time after

planting, the seed rots. Soils that are generally wet at planting time must be artificially drained if they are to be used successfully for vegetable crops.

The Temperature Factor.—The temperature factor is a highly important one in seed sowing. Certain kinds of vegetable seed germinate and the plants develop better at a given temperature than others. Such kinds as radish, lettuce, peas, cabbage, and beets grow and thrive well at rather cool temperatures (50° to 60° F.); whereas, tomato, eggplant, corn, and pepper require a warmer temperature (65° to 75° F.), both for the proper germination of the seed and plant development. The cool season crops are sown or set much earlier in the spring than are the warm season plants. Considering the soil and air-temperature factor in their relation to the sowing of seed in the home vegetable garden, as a general practice it is better to delay planting until the temperature is settled. On the other hand, very early crops are sometimes obtained by taking the risk and making small plantings very early in the season. If the weather turns cold, and kills the young seedlings, nothing is lost but the seed; while if there is no change, which is the case occasionally, very early vegetables are secured.

Planting Dates.—The planting dates for each vegetable are placed on the planting plan, and with this to follow it is easy for the gardener to make the sowings at the proper times to provide the different vegetables when they are desired.

Depth.—The proper depth for sowing vegetable seeds depends upon the size and kind of seed planted, the season, and the type and moisture content of the soil.

Large seed, as a general rule, possess greater vitality than smaller seed and are planted deeper. The kind of seed influences the depth, as for example, celery seed is planted in the seed-bed right at the soil surface. Lima beans, although large, are not planted as deeply as some other seed that are smaller, because considerable energy is required to push the bean above the soil after germination has taken place.

The season influences the depth of planting in that it has to do with the soil temperature. Early in the season, when

the soil is cool, seed of the same vegetable are sown shallower than later in the season when the soil has warmed to a good depth and has become dried.

Seed are planted shallower in stiff, heavy soils than in light loams. The seedlings have greater difficulty in making their way to the surface in a heavy soil than when planted in a loose soil, and it is also preferable to plant deeper in the loose soil to obtain the proper moisture conditions. Seed may be planted shallower in soil that has been carefully fitted, as the soil particles are finer and the moisture has been conducted nearer to the surface. The amount of moisture in the soil in the spring is relatively greater than in summer. This, coupled with a low temperature, makes it necessary to plant at a shallower depth than later when the soil has lost some of its moisture.

As a general practice the smaller seed, like radish and beet, are sown from ½ to 1 inch deep, and the larger ones, such as bean and corn, at a depth of 2 or 3 inches.

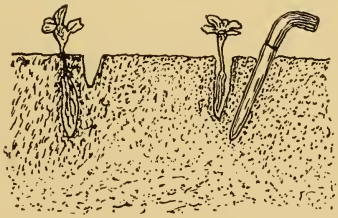

Fig. 71.—Proper method of setting seedling plants at the right.

Method of Sowing.—Garden seed are sown in drills or hills from between the fingers or with a seed drill. If they are to be planted by hand, the rows are marked by stretching a garden line lengthwise across the garden, and fastening it to the two stakes, one at each end of the row to be planted. A small furrow or trench is next made with a sharp stick, or the corner of a hoe blade, along the line at the proper depth. The seed are then sown as evenly as possible,

covered, and the soil firmed well, to bring the seed in close contact with the soil.

The seed drill is fitted with a marker which makes the use of the garden line unnecessary. Directions are furnished with each seed drill to be followed in making the proper adjustments for planting different kinds of seed, and for securing the proper depth of planting. A trial test should be made for each kind of seed with the drill, allowing the seed to be dropped on the ground, to determine if it is sowing the right amount. The soil must be in the best possible physical condition, with no lumps or clods, if a seed drill is to be used for doing the planting.

Distances.—The distances between plants in the row will be considered later, under cultural directions for each crop. Seed of some vegetables are sown in drills and others planted in hills. The distance between rows is determined and shown when the garden plan is made, and depends upon the method of cultivation to be pursued, the habit of the plants grown, and the richness of the soil.

If horse tools are to be used for cultivating, the rows would hardly be less than 3 feet apart, irrespective of the habit of growth of the plants, and the richness of the soil. Where the cultivation is done with a hand cultivator and hoe, the distance between rows may vary from 18 to 30 inches, depending upon the size of the vegetable plants to be grown. Radish, lettuce, beet, and spinach thrive well at 18 inches; and corn, cabbage, tomato, and egg plant require a distance of at least 30 inches between rows. A rich soil permits of closer planting than one deficient in plant food. Where the most intensive methods are being followed, the smaller growing vegetables are planted with the rows as close as 12 inches, but unless land is very scarce, a distance of 15 to 18 inches is much more desirable.

CHAPTER IX.

GARDEN MANAGEMENT.

Labor.—The item of labor for managing the garden must be carefully considered by every home gardener. It has been the writer's experience in inspecting a large number of farms in the Middle West, that but few are given the necessary time to keep them in a thrifty condition. On some of the most up-to-date farms it is not uncommon to find a weedy garden patch at the rear of a fine dwelling. In plain words, the garden is neglected and most owners will agree to this fact, stating that during the rush of early summer work the garden is quite forgotten, and receives only the care that the housewife can give it. Planning the labor has been discussed previously and it only remains to state that the required amount of time, although small, must be spent on the garden if the owner is to realize the greatest pleasure and profit therefrom.

Cultivation.—This practice is necessary in the garden to provide a dust mulch on the soil surface and thus prevent evaporation, to kill weeds, and to aerate the soil so as to let in heat and water which act chemically upon the plant food and make it available for growing crops.

One of the greatest offices of cultivation is that of preventing evaporation. In order to mature a crop properly the necessary moisture must be available for the plant to take up. Every season has its drouth which may be serious in our climate for only a few days, and still its results may be so great as to reduce the yields materially. A good soil mulch will tide over this period in many cases, making the injury slight. The mulch is provided by frequent shallow cultivations. The dry dust mulch acts as a non-conductor of moisture and keeps the moisture in the seed-bed for the use of the plants. The soil close to the plants that cannot be reached with the

cultivator is worked with a hoe. Some hand work may also be necessary to keep a crust from forming between plants in the row.

Weeds are injurious to the crops in that they rob them of moisture, plant food, and light. The most important consideration in controlling them is to begin early and destroy them soon after they have appeared above ground. In order to keep weeds from getting a start, it is a good practice to rake over the garden lightly with the garden rake two or

FIG. 72.—Raking over the garden a few days after seed sowing will form a dust mulch and help to keep down weeds. It should be done lightly over the rows.

three days after sowing. This will kill the early weeds which generally get a good start before the plants from vegetable seed start germinating, thus making unnecessary a large amount of hand weeding that would otherwise be required.

Cultivation aids in the liberation of plant food by putting the soil in such a condition that soil bacteria in large numbers can thrive in it and break down the organic matter present in the soil. Frequent cultivations for this purpose are especially desirable in garden operations where large quantities of quickly available plant food are required.

Depth.—The depth to cultivate depends upon the crop, the soil, and the age of the plants. In general, it is best to cultivate from 2 to 3 inches deep, and up close to young plants, and gradually increase the distance from the plants and decrease the depth as the season advances. Shallow, level cultivation with a tool having several small teeth, in preference to one having large shovels, is to be recommended.

FIG. 73.—The double-wheel hoe should be provided for cultivating the small garden: Select one that has a high arch and fair sized wheels.

Amount.—The amount of cultivation varies with the soil and the season. With soils that form a crust and have a tendency to bake, cultivation is necessary after each rain. In dry seasons, frequent shallow cultivations are desirable on any type of soil to prevent evaporation.

It is quite impossible to state just how much cultivation will give the best results, as there are so many varying factors. The Purdue Experiment Station conducted a

series of cultivation tests with the tomato grown as a field crop, the nature and results of which were as follows:

It was the object in conducting this experiment to secure data from which could be established the relationship existing between the kind and amount of cultivation given the tomato grown as a field crop and the yields produced. It was desired, in other words, to compare the effect of thorough cultivation with average cultivation upon the yields and profits.

This test consisted of two plots, one of which received a small amount of cultivation, corresponding closely to that given by some growers, while the other plot received thorough cultivation. Both plots each season were located on land that had received the same soil treatment as regards cultivation and fertilization the year previous and were uniform in this respect. Other than the cultivation given, the plots were handled in exactly the same manner.

In Table VII is given the number and dates of cultivation, cost of cultivation, etc., for the three seasons' work. During 1910 plot 1 was given four cultivations and plot 2 fifteen cultivations and eight hoeings. In 1911 plot 1 received three cultivations and one hoeing and the amount given plot 2 was reduced to nine cultivations and two hoeings. During 1912 plot 1 received but three cultivations and plot 2 eight cultivations and one hoeing. The cost per acre for the cultivations and hoeings is included in the last column of Table VII. The figures are based upon the actual average cost of $0.50 per acre for each cultivation and $1.50 per acre for hoeing.

The first cultivation for both plots each season was 4 inches deep and quite close to the plants in the row. Subsequent cultivations were 2 inches deep and the land left as level as possible. Plot 2 was kept in the best condition throughout the season. After each rain the soil was stirred and a dust mulch provided at all times to prevent evaporation of moisture. Plot 1, receiving three or four cultivations per season or approximately the average amount for the State of Indiana, presented an unsatisfactory appearance almost from the start. In 1910 and 1911 weeds sprang up during the

latter part of the season and considerable amounts of moisture were lost on account of lack of a dust mulch. The plants did not present as thrifty an appearance and did not grow as rapidly as those in plot 2.

TABLE VII.—SHOWING NUMBER AND DATES OF CULTIVATION AND COST PER ACRE DURING 1910–11–12 FOR PLOTS RECEIVING AVERAGE AND THOROUGH CULTIVATION.

Plot No.	Number and dates given.			Cost per acre.		
	1910.	1911.	1912.	1910.	1911.	1912.
I Average cultivation	4 cultivations June 14 July 4 July 21 Aug. 19	3 cultivations June 2 June 21 July 22 1 hoeing June 10	3 cultivations May 25 June 12 July 1	$2.00	$3.00	$1.50
II Thorough cultivation	15 cultivations June 14 June 16 June 20 June 21 June 24 June 25 July 2 July 7 July 21 July 27 Aug. 3 Aug. 6 Aug. 12 Aug. 19 Aug. 27 8 hoeings June 24 June 30 July 12 July 21 July 26 Aug. 12 Aug. 20 Aug. 30	9 cultivations May 26 June 2 June 6 June 15 June 21 June 28 July 5 July 11 July 22 2 hoeings June 10 July 22	8 cultivations May 25 May 27 May 31 June 12 June 13 June 21 June 24 July 1 1 hoeing July 20	$19.50	$7.50	$5.50

The effect of these methods of treatment upon the yields are given in Table VIII. In this table it will be seen that the

amount of cultivation had little effect upon the earliness of bearing, since there is only from one to three days difference in favor of thorough cultivation.

The yields reported in this table show a much larger amount on plot 2 than on plot 1 which received but an average amount of cultivation. In 1910 there was a difference in yield of 2.11 tons, in 1911, 4.03 tons and in 1912, 3.87 tons all in favor of thorough cultivation. The ratio between the amounts of first- and second-grade fruits, however, was quite constant. The wide range existing in this table between the yield in 1910 as compared to the yields of 1911 and 1912 is due to the small size of the plants when they were set and to the length of the season which was two weeks shorter.

In the last column of Table VIII is given the value of the annual crops less the cost of cultivation, and it is here that accurate comparisons between the two methods of cultivation employed are to be made. In 1910 fifteen cultivations and eight hoeings produced only $3.60 more profit per acre than four cultivations. The results of 1911 show a gain of $35.80 for nine cultivations and two hoeings over three cultivations and one hoeing. In 1912 the difference was $34.70 gain per acre for eight cultivations and one hoeing as compared with three cultivations.

After the first season's results had been secured it was at once evident that the large number of cultivations given to plot 2 cost almost enough more to take up the value of the extra yield produced. The following season with something definite upon which to base calculations the amount given to the carefully cultivated plot was reduced by about half.

On a type of soil similar to the one upon which these cultivation plots were located, seven or eight cultivations given from the middle of May, when the plants are set, to the third week in July, when the plants nearly cover the ground, followed two or three weeks later by a thorough hoeing to remove all weeds, will give the most profitable returns. On other soils general recommendations regarding the amount of cultivation to give the tomato will probably not vary much from the amount found most valuable in this test.

TABLE VIII.—GIVING PICKING SEASON, YIELDS PER ACRE AND VALUE OF CROPS LESS COST OF CULTIVATION FOR PLOTS RECEIVING AVERAGE AND THOROUGH CULTIVATION.

Plot No.	Picking season.			Tons yield per acre.									Value crop less cost of cultivation.		
				1910.			1911.			1912.					
	1910.	1911.	1912.	1sts	2ds	Total.	1sts	2ds	Total.	1sts	2ds	Total.	1910.	1911.	1912.
I Average cultivation	July 23 Oct. 1	July 17 Oct. 11	July 19 Sept. 19	2.16	.36	2.52	8.87	.88	9.75	8.42	1.07	9.49	$23.20	$94.50	$93.40
II Thorough cultivation	July 22 Oct. 10	July 14 Oct. 11	July 17 Sept. 19	4.26	.37	4.63	12.69	1.09	13.78	11.88	1.48	13.36	26.80	130.30	128.10
Net profit from thorough cultivation													$3.60	$35.80	$34.70

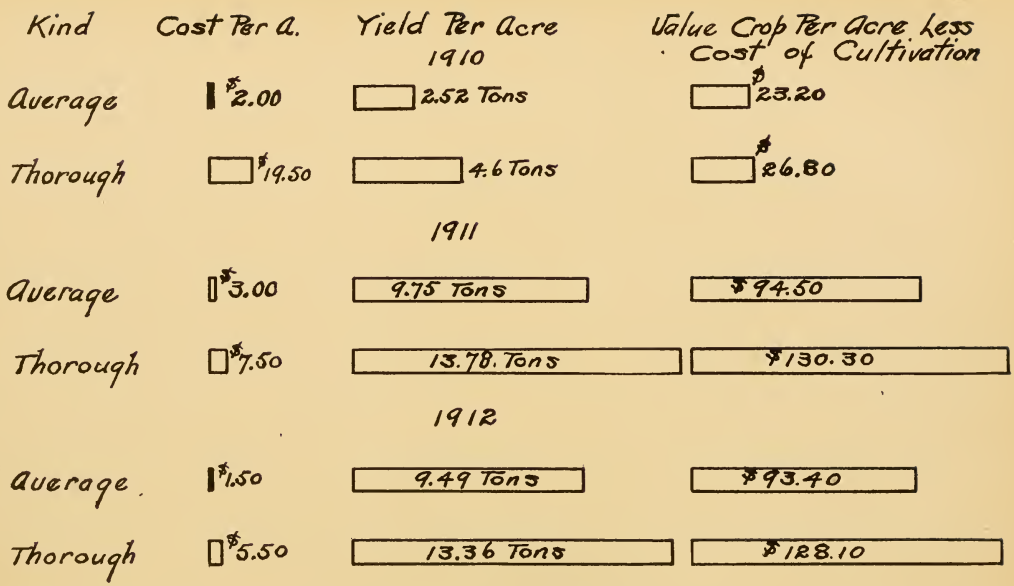

FIG. 74.—Summary of three years' results secured from average and thorough cultivation. The chart compares the two methods from the stand-point of cost per acre, yield per acre and value of crop less cost of cultivation. Crop value is taken as $10.00 per ton for ripe sound tomatoes.

From these results, it is seen that the amount of cultivation given has a direct bearing upon the crop yields and the profits. The amount recommended for the tomato should prove quite satisfactory for the home garden under average conditions.

Weeding.—Hand weeding is always necessary in the garden. The amount required varies directly with the kind, frequency, and carefulness of the cultivation. By going slowly and working close to the rows with the cultivator when the crop is young, most of the weeds can be controlled. The hoe can

FIG. 75.—Different types of cultivators used with one horse. The one at the left is well adapted to making a dust mulch if the soil is loose and free from weeds.

be used to supplement the work of the cultivator, and many weeds cut out with it. Then with crops like the onion, where the plants are very close together in the row, some hand weeding is necessary. Small weeds can be pulled at any time, but those that have grown large should be pulled when the soil is moist, in order not to injure the vegetable plants that are to remain.

Thinning.—With all vegetables drilled in rows, thinning is a necessary practice. The amount of thinning may be reduced to the minimum by considering the germination test

and then planting only a slightly larger amount than the vitality of the seed indicates is needed to secure the desired stand. Crops like lettuce, radish, and early beets are thinned when the first plants are large enough to use. Most garden vegetables must be thinned before the plants have begun to crowd one another in the row. Crowding soon stunts all of the plants and checks the development of those that are left to mature. Do the work early in the development of the crop and at a time when the soil is moist, to prevent injuring the plants that are to remain after the others are pulled.

The proper distance should be maintained between the plants from the beginning, as too much is preferable to too little space. When the plants are small there is a tendency to leave them too close together, and if every other one is taken out later, in an attempt to thin them, there is too much space left between plants. The right distance should be established at the beginning of the work and then checked occasionally to keep it uniform thoroughout.

Staking.—The tomato and some varieties of peas and beans require stakes or poles to keep the plants off the ground.

Stakes 4 to 6 feet long, driven into the ground until they are solid, are used for staking tomatoes. One stake is driven close to each plant, and as the plant grows, it is tied to the stake at intervals of about 12 inches, with raffia or some material that will not cut. Barrel hoops and sometimes strands of wire are used for supporting tomatoes, the former being supported by two or three stakes driven into the ground about each plant, and the latter method being handled similar to the way grapes are supported.

Peas are commonly supported by small brush or by stretching a piece of chicken-wire netting along the row for the plants to cling to. Pole beans are supported by stakes or poles 8 to 12 feet long, driven firmly into the ground.

Irrigation.—With the advent of pneumatic water-pressure systems in country dwellings, and the usual available water supply in towns and cities, means are already provided for the irrigation of the small area devoted to garden purposes.

Wherever water is to be had under pressure or in any other form that will supply an abundance of it, inexpensive garden irrigation equipment will be all that is required.

The normal growing season is generally attended with one or two serious drouths which are of short duration, but severe enough to affect seriously some vegetables which are especially susceptible to drouth. Water applied in moderate amounts at these times will carry the plants through the dry spell without the growth being checked. Many seasons two or three thorough applications of water at the proper times will double or treble the yields and greatly improve the quality. Even in humid regions an irrigation system for the garden will prove a valuable insurance against drouth and the greatest success in gardening can only be had when irrigation practice is followed during dry seasons.

There are three methods that may be followed in applying water to the growing crops:—the overhead or sprinkler system, sub-irrigation, and surface irrigation.

The Overhead or Sprinkler.—The overhead or sprinkler system will prove the most satisfactory for the amateur. A lead of 1-inch galvanized pipe is fitted with a small nozzle every 2 feet on a straight line on one side of the pipe. The pipe is extended across the garden on wooden supports from 4 to 8 feet above the ground. It is then connected with a hose to water under pressure. As the water passes through the small nozzles it is broken up into a fine mist which moistens the soil gradually and does not cause it to pack or bake. When a certain strip of land has received a sufficient amount, the pipe is revolved until water is thrown in a new position. With ordinary city water pressure (40 to 60 lbs.), a strip 16 feet wide can be irrigated in this manner without changing the pipe and its support to a new place. A good length of garden hose can be used to carry the water from the hydrant to the pipe as the latter is changed and one length of pipe be made to answer the purpose. With this system the water can be applied at any time during the night or day.

With water under pressure at hand, the cost of installing and operating the sprinkler system will be very low. A piece

of pipe of sufficient length to extend across the garden, a nozzle costing five cents, for every 2 feet in length of pipe, a cap and three or four wooden supports make up the outfit. After the connections have been made, the water is turned on and the apparatus is in working order.

The advantages of this system are: that it is easily and cheaply operated, does not cause the soil to bake or puddle even when excessive amounts are added, distributes water uniformly, does not injure the plants, and is not a costly system to install. Its only disadvantage is that some of the water is lost through evaporation.

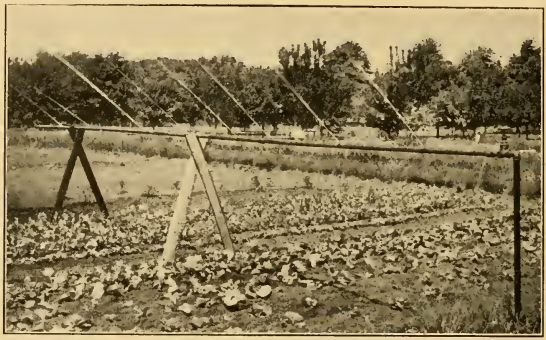

Fig. 76.—The overhead or sprinkler system of irrigation can be successfully operated by the amateur. Water under pressure must be available if this system is to be used.

Subirrigation.—Subirrigation is practised by laying 3- or 4-inch tile 20 inches below the soil surface with a fall of 1 inch to 100 feet. Parallel lines are laid 12 to 15 feet apart lengthwise of the garden and serve both for drainage and irrigation purposes. An entrance to each line of tile at the upper end and a means of stopping the lower end are provided. Water is then admitted through the entrance and finds its way into the soil between the openings at the ends of the tile.

This system of irrigation is easy to operate and prevents the loss of moisture by evaporation. Its principal disadvantage is that the water is not uniformly distributed, the soil adjacent to the tile being wet, while that several feet away may receive little or no moisture.

Surface Irrigation.—Surface irrigation consists in flooding the land by means of water carried through furrows on the surface of the soil. The furrows are placed close enough together so that the water will percolate through the soil from one to the other.

This method is the least desirable of the three for the average home garden. Artificial trenches must be constructed at each irrigation, and after the water has soaked into the soil the surface may puddle and bake unless properly handled.

Amount of Water.—The amount of water to apply is governed by the season, the soil, and the crops grown. During the average season in the Middle Western States, only a small amount of water will be required for garden irrigation. The applications of water are made at infrequent intervals when the soil has become dry during periods of drouth. Such soils as the sandy loams generally require more water than the heavier types during dry spells. The exact amounts to add can be determined only by experience with the soil being used. In the garden where a variety of vegetables is grown there is little opportunity to regulate the amount of water applied to each crop.

The directions given in an earlier chapter for watering hot-beds apply quite as well to outdoor irrigation. Sufficient water should be applied to moisten the soil well down below the roots and at the same time a water-soaked soil should be avoided. Water from cold springs, or that has been recently pumped from deep wells, may be cold enough to injure the growing crop. The temperature should not be much below 60° F.

In order to conserve the moisture that has been added by irrigating, the land is cultivated as soon as it has become dry enough. This prevents the formation of a crust, and creates a dust mulch which reduces evaporation to the minimum.

CHAPTER X.

INSECT AND DISEASE CONTROL.

UNDER home garden conditions with only small quantities of each vegetable being grown, the pests which attack these crops are not numerous, and, if proper precautions are taken, are not difficult to control. Timeliness is very important and likewise is a knowledge of the kinds of pests, their life habits, and the most reliable methods of holding them in check.

Classification.—Garden pests are grouped and classified as follows for the convenience of the gardener who must control them. The scheme is based upon the kind of pest, its habits, and methods of control.

I. Insects
  (*a*) Chewing mouth parts
  (*b*) Sucking mouth parts
II. Fungi
  (*a*) External feeders
  (*b*) Internal feeders
III. Bacterial Diseases.

INSECTS.

The most destructive class of pests with which the gardener has to contend is insects. Although the most destructive, they are easy to detect and not difficult to control in most cases. In order to control them with the greatest degree of success, the grower should be able to recognize on sight the insect that is doing damage, know how it feeds, and what methods are best adapted for its control.

Mechanical Methods.—Mechanical means are used with some vegetable crops for warding off the attacks of insects. The principal upon which they are based is that of preventing

the insect from reaching the plant until a time when the plant is able to withstand its attack or until the insect is no longer present.

Screen Domes.—Screen domes, or window screen pressed into different shapes, are placed over melons and cucumbers to prevent the cucumber beetle from killing the young tender plants. This insect is difficult to control by spraying, is a serious menace to the young vines, and consequently is kept away from the plants by actually covering them with

FIG. 77.—Cones made of door screen placed over young cucumber plants to protect them from the cucumber beetle. Practicable in the home garden but not on a field scale.

a screen dome, or perhaps a protector made by using a wooden frame covered with mosquito netting. After the vines have reached some size and are becoming woody, the beetle is able to do them but little damage, and when this stage of development is reached, the protectors are removed and the plant allowed to make its natural growth.

Paper Bands.—Paper bands placed around the stems of such plants as tomato and cabbage when they are set, with the band extending an inch or two above and below the soil, will prevent cut worms from destroying the young plants.

Hand Picking.—Hand picking the eggs or the insects of such as the tomato worm, cabbage worm and potato beetle, is sometimes practised, the insects or eggs being destroyed or killed by burning, or by putting them in hot water or kerosene. The tomato worm may be controlled by clipping them into two parts with a pair of scissors.

FIG. 78.—Protecting transplanted plants from the attacks of cutworms. A 3-inch band of paper is placed around the plant when set. The band extends 1 inch below the surface of the soil.

Trap Crops.—Trap crops are sometimes planted with such plants as the cucumber or melon for controlling the striped beetle. The seed of squash, for example, are planted in advance of the regular crops and when the insects are collected on the early plants they are destroyed. In this way a large proportion of the insects are killed before the plants of the main crop are up.

Poisoned Baits.—Poisoned baits are of value for controlling such insects as the cutworm. The baits are prepared by dipping small balls of clover in a solution of Paris green and water and dropping them about the garden a few days before plants are set, or a few days after seed are planted. Poisoned bran mash sweetened with sugar or molasses, is also used very successfully. It is distributed late in the afternoon so

that it will still be moist in the evening when the worms feed. Poultry and stock should be prevented from obtaining the baits.

Repellents.—Repellents, such as turpentine or crude carbolic acid mixed with a fine powder like land plaster or screened ashes and dusted onto the plants, prove effective in keeping away some insects. Tobacco dust, air-slaked lime, and Bordeaux mixture are also valuable repellents. Flea-beetles and the striped beetle are controlled to a certain extent by the use of these materials.

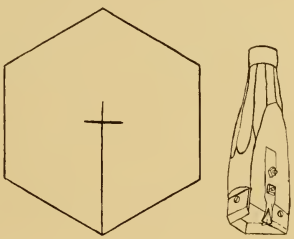

FIG. 79.—Tar paper pad used in protecting cabbage from the maggot; at the right is a tool used in cutting out the paper. (The Country Gentleman.)

Fumigants.—Gases are used as fumigants in controlling insect pests that are common to the greenhouse or conservatory and for those that attack seed.

Hydrocyanic Acid Gas.—Hydrocyanic acid gas is employed as a fumigant for greenhouses and conservatories. It is made by combining cyanide of potassium, sulphuric acid, and water. One ounce of the potassium cyanide is required for every 1000 cubic feet of space. The gas generated is slightly lighter than air, and is a deadly poison and should be handled only by those who are familiar with its use. It is employed for controlling the white fly and other greenhouse pests that are very hard to destroy.

Tobacco Stems.—Tobacco stems may be burned in the greenhouse, the fumes being of value in the control of plant

lice. A solution of nicotine sulphate placed upon the heating pipes will produce desirable results. The same material may also be purchased in the form of paper which has been saturated with tobacco extract. The paper is burned in the greenhouse which causes the tobacco fumes to be given off. Melon vines may be rid of plant lice by fumigating with tobacco paper under a frame covered with cloth that has been sized with linseed oil.

Carbon Bisulphide.—Carbon bisulphide is used against insects affecting grains or seed. Weevils of the pea and bean are controlled by placing the seed in an air-tight vessel and then setting on top of the seed a shallow dish containing carbon disulphide. The receptacle is then closed tight and the rapidly evaporating liquid forms a gas heavier than air, which penetrates to every part of the enclosed space. The seed are allowed to remain in the gas for several hours to make certain that all of the weevils are killed. One pint of the material for each 1000 cubic feet of space is used. Fire of every kind should be kept entirely away from the gas, as it is very inflammable. The gas is also poisonous if breathed in large quantities.

Crop Rotation.—The rotation of crops when grown on a field scale is a valuable aid in insect control. Many insects hibernate in the soil or live over in crop refuse from one season to the next. By planting the crop on new land somewhat distant from the field used the previous year, serious attacks may be avoided. The value of rotation in the garden is not as important as in field culture since the area is so limited in extent. Yet, even here, some good may come from the stand-point of insect control by following a systematic rotation of vegetable crops.

Sanitary measures, such as collecting and burning all crop refuse and weeds in the garden at the end of each season, will greatly reduce the amount of infestation the succeeding year. This is especially important with those crops that have been seriously affected by certain pests. Under the latter conditions the refuse should never be carried to the compost heap, but should be destroyed as soon as possible after it accumulates.

Plowing the garden in the late fall is known to control some insects by breaking up their winter quarters and leaving

FIG. 80.—Adult and larva of the common cut worm. This larva is controlled by mechanical methods or with poisoned baits.

them exposed to the weather and their enemies. Cultivation during the growing season also helps to control those insects that may be living or pupating in the soil.

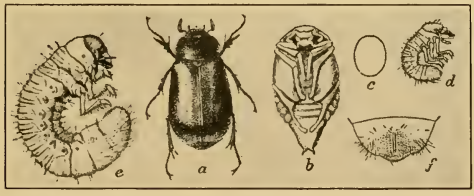

FIG. 81.—Different stages in the life cycle of the June beetle. The larva or grub worm as it is commonly called is shown at the left.

Spraying.—All of the methods previously given for controlling insects are of value, but will not compare in efficiency with the practice of spraying. Many of them can only be held in check by applications of spray mixtures and a majority can be completely controlled by this method. Modern methods of spraying are of recent introduction,

having been developed almost entirely during the last thirty years. From the whisk broom for applying and a 2- or 3-gallon bucket for carrying the spray material, down to our present-day power outfit has been the rapid development in this short period. Spray chemicals have also undergone as great a change. Spraying is still in its infancy and marked advances in practice may be expected during the next decade.

Spraying practice is based upon the principle of covering the plant with a thin and uniform layer of spray material, the latter being of such a nature as to kill the insects under consideration.

Timeliness.—Timeliness is of supreme importance in spraying vegetable crops. For the potato beetle and other insects of similar habits the poison should be applied just as the eggs are hatching and the young larvæ are beginning to develop. At this stage but a small amount of poison is necessary to kill them, only small quantities of the foliage are eaten, and consequently the plants are not checked in their growth. The insects are also all killed in the larval stage which prevents any of them from passing into the adult or beetle stage, from which a new brood originates. Early applications, when the plants are small and before the insect has multiplied, are much cheaper to apply and more efficient.

Thoroughness.—Thoroughness is necessary for successful results in applying all spray mixtures. For chewing insects and fungi it is desirable to have a thin film of the dried spray material on every part of the plant that is attacked by the pest, which means with vegetables that the whole plant must be covered. To control sucking insects effectively the spray material must be brought in actual contact with the body of each insect. In order to meet these requirements and yet not waste considerable amounts of spray materials the grower will need to give careful attention to this method of pest control.

Proper Materials.—Proper materials for controlling each insect is the next consideration. Often a fungicide is wrongly used for killing insects. Perhaps a poison is used for con-

trolling an insect with sucking mouth parts. Neither of these will prove successful when used as just indicated. Each spray material is designed to check or completely eradicate a certain class of pests and when used for other purposes is almost useless. If the grower is to select the right spray materials for destroying the pests which attack his crops, he must first be able to identify them, and next be able to determine whether they are chewing or sucking insects.

FIG. 82.—A parasitized tomato worm. The parasites will develop and eventually kill the insect. The larva can be poisoned when small.

Chewing Insects.—Chewing insects devour portions of the leaves and stalks of cultivated plants. The larvæ of the potato beetle strip the potato plant of all of its leaves, and leave nothing but the stalks, if allowed to take their course. Some chewing insects are more voracious feeders than others, although all of them will prove destructive if not taken care of at the proper time.

For this class of insects a poison is used such as arsenate of lead or Paris green. Both of these preparations contain arsenious acid in moderate amounts, which quickly destroys insect life when taken internally with their food. By coating

vegetable plants with a thin layer of either of these poisons whenever chewing insects are present, the grower is able to eradicate them quickly.

Sucking Insects.—Sucking insects take their food by inserting their beak-like mouth parts through the epidermis of the leaf or the bark of the plant into the live tissue. By the aid of their sucking mouth parts they are then able to remove the juices of the plant in a manner similar to the way the mosquito secures its food. Aphids or plant lice, are common garden pests belonging to this class. They attack the fleshy stalks and the under side of leaves, causing the latter to curl up to such an extent that they afford protection by preventing the spray material from reaching them. This makes it important to spray when the insect first appears.

FIG. 83.—A squash stem cut open showing borers within. The pest is controlled by destroying old vines, rotating and planting trap crops. (The Country Gentleman.)

A poisonous insecticide will be of no value for this class of insects which does not eat the external parts of plants. The only materials that will destroy them are contact insecticides such as nicotine sulphate and kerosene emulsion. These materials kill by their caustic action, or by being absorbed into the tissues of the insect, upon the bodies of which the spray has been applied.

FUNGI.

A fungus is a low form of plant growth. It differs from our common plants in that it has no redundant chlorophyl and is therefore unable to manufacture plant food. This

function is not necessary to its welfare, since all fungi are parasitic and are able to exist by absorbing the plant juices of the host plants upon which they are located. In plain words, they are robbers and steal their sustenance from the higher plant forms.

Fungi in general attack the fruit, leaves, stems, and roots of plants. Some forms attack one or perhaps only two of the parts just mentioned. When present in large numbers they may seriously check the development or even kill vegetables upon which they are working. This pest is propagated by minute spores which are disseminated by the wind and insects.

Classes.—As previously indicated, fungi fall into two groups known as external feeders and those that work within the tissues of the plant.

The first class, including such fungi as mildews, attaches itself to the surface of the host plant and may be entirely removed by rubbing the portions affected. This type of fungus is not difficult to control even after it has reached an advanced stage, for all parts can be reached and destroyed by surface applications of the proper sprays.

The second group, which sends its root-like parts down into the plant tissues, cannot be eradicated after it is once established. The parts on the exterior of the plant can be readily destroyed by spraying, but those growing on the interior cannot be reached. For this reason fungi which work largely on the interior of plants are difficult to control. Since it is not possible to destroy them after the spores have germinated and have penetrated into the interior, it is necessary to spray at such a time and with such a material that the spores or the germ tubes are destroyed. In order to accomplish this end vegetable plants must be kept covered with a thin film of Bordeaux mixture so that whenever spores alight on the plants they will be destroyed immediately, or at least when they begin to germinate. Spraying is an insurance against, rather than a curative for, internal feeding fungi which attack the aerial portions of plants, and therefore applications must be made at the proper times and in a thorough manner if good results are to be obtained. Fungi

belonging to this class are: potato blight, potato scab, and bean anthracnose.

FIG. 84.—Tomato leaf spot as it appears on the under side of the leaves Bordeaux mixture applied early in the season will aid in controlling this fungous disease. (The Country Gentleman.)

Control Measures.—The sanitary measures previously given for controlling insects apply with equal force to fungous diseases.

Clean Seed.—Clean seed is the next important consideration. With many vegetables fungous troubles are introduced with the seed planted. If seed are home grown it is desirable for the gardener, when saving a supply for the succeeding year, to take them only from plants that are free from any disease whatsoever, and to thresh and store them so that there will be no chance of infection. This practice is common in selecting bean seed and will apply to other vegetables as well.

Vegetable seed may be treated to kill fungi that may be present on them. Potato scab is prevented from being carried over on infected seed by soaking the seed tubers for

two hours in 30 gallons of formalin solution prepared by placing 1 pint of 40 per cent. formalin in 30 gallons of water. Other seed could perhaps be similarly treated with equally good results.

Plant beds used more than one season for starting plants are freed from fungi by drenching with a solution composed of 1 gallon of 40 per cent. formaldehyde to 50 gallons of water. One-half gallon per square foot of surface is required, two or more applications being made as evenly as possible, to avoid waste and to insure an even penetration of all the soil. The formalin vapors are allowed to escape before sowing seed.

Spraying:—Spraying constitutes the most reliable method for combating fungous diseases in the garden. The standard fungicide for vegetables is Bordeaux mixture, the active part of which is the copper which destroys the spores and parts of fungi with which it comes in contact. Sulphur used as a powder and potassium sulphide in liquid form may be employed for controlling surface-feeding fungi, such as some of the mildews.

BACTERIAL DISEASES.

These diseases are the results of bacteria which are still simpler forms of plant life than fungi. Each organism consists of a minute single cell which, although it may be grouped with others, is complete in itself, having the power to collect food and to reproduce itself by division. Bacterial diseases of vegetables are not large in number and yet they are the most destructive class of pests. Working on the interior of the plant as they do, it is impossible to control them by spraying, and other remedial measures are not very effective. Black rot of cabbage, bean blight, and melon wilt are common forms of bacteria which attack vegetable crops.

Control Measures.—Bacterial diseases are spread by insects and perhaps by the wind, water, and the cultivator. Entrance is made through the flowers or the young succulent shoots of the host plant. Since the pest cannot be controlled after it has made an entrance into the plant tissues, control measures consist of prevention rather than cure. The use

of clean seed selected from plants free from disease, and crop rotation, aid in keeping plants free from bacterial attacks. With crops grown on a field scale, it sometimes becomes necessary to omit the growing of such plants as cucurbits for five or six years, as the wilt remains viable in the soil during this period.

Cleaning up and destroying dying or dead plants, weeds, and refuse in the garden will reduce the possibility of infection.

SPRAY MIXTURES.

Spray mixtures are classified according to the purpose for which each is used into poisonous insecticides, contact insecticides, and fungicides.

Insecticides.—There are a considerable number of home-made and proprietary insecticides that are used by growers for controlling insects. Only the most valuable ones will be mentioned here.

Poisonous Insecticides.—Poisonous insecticides are used for destroying chewing insects. They are taken into the digestive system with the portions of the food devoured, and are rapid in their action. Paris green and arsenate of lead are the two most important poisons used for the chewing class of insects.

Paris green is used at the rate of one-fourth to one-half pound per 50 gallons of water. For each 50 gallons of material prepared add 1 pound of stone lime slaked just before it is put in. The office of the lime is to neutralize the free arsenious acid in the solution which would otherwise burn the foliage of the plants to which it is applied. After the lime has been slaked and added to the quantity of water, mix the Paris green with a little water into a thin paste and stir it into the previously prepared solution.

Arsenate of lead is purchased in the form of a powder or paste. The powder is about twice the strength of the paste, although there is little difference in the efficiency of the two when used at the proper strengths. Arsenate of lead paste is used for vegetable spraying at the rate of 2 to 4 pounds per 50 gallons of water. One-half of this amount of the

powder is used. This poison is generally preferred over Paris green as it does not injure the foliage, is not dissolved so easily by rains, does not settle so rapidly in the spray tank, and is more adhesive.

Either dry or powdered arsenate of lead should be mixed with small quantities of water into the form of a thin paste before adding them to the full amounts of water. With vegetables like cabbage, which have broad smooth leaves, the addition of 2 pounds of soap to each 50 gallons of this spray material will cause the liquid to spread evenly and cling to the leaves. The soap is dissolved in about a half-gallon of water over a fire, then added and thoroughly agitated. Soap should be used only when arsenate of lead is used alone.

Contact Insecticides.—Contact insecticides are used for controlling sucking insects. Nicotine sulphate, or Black Leaf "40" is one of the most important contact insecticides from the stand-point of the home gardener. It can be used with safety on growing plants and is in general use for controlling plant lice. This material can be purchased on the market, and is diluted at the rate of three-eighths of a pint to 50 gallons of water. For onion thrips it is reduced to one-fourth pint to 50 gallons of water.

With hard water and when nicotine sulphate is used alone, a soap "spreader" is quite desirable. Two-thirds of an ounce to 1 gallon, or 2 pounds to 50 gallons of water, will assist in preventing the small drops of spray from running together and off from the plant.

Whale oil soap and kerosene emulsion are older contact insecticides and are still used to a certain extent. The former is used at a strength of 1 pound to 6 gallons of water. Kerosene emulsion is made as follows:

Kerosene	2 gallons
Water	1 gallon
Soap	½ pound

Heat the mixture of soap and water until the soap is dissolved, and add the solution boiling hot to the 2 gallons of kerosene. After churning with a force pump or paddle until well emulsified, dilute the stock solution ten to twelve times with water before applying.

Fungicides.—About the only spray mixture in which the vegetable grower is interested for controlling fungous diseases is Bordeaux mixture. This spray is made by combining copper sulphate, lime and water. The copper sulphate is the active agent, the lime being added to prevent caustic action on the foliage.

Formula:

Copper sulphate	4 pounds
Stone lime	4 pounds
Water	50 gallons

If hydrated lime is substituted for the stone lime, the amount used should be increased to six pounds. Air-slaked lime should never be used.

In the preparation of Bordeaux mixture the copper sulphate is dissolved in 25 gallons of water. The stone lime is slaked and diluted to 25 gallons in a second vessel. The two solutions are then poured simultaneously through a strainer into the spray tank.

"When the copper sulphate solution and milk of lime come in contact a sky-blue precipitate is formed. If the material has been properly prepared, this precipitate will be light and flocculent and will stay in suspension with a minimum of agitation. Never mix the copper sulphate solution and milk of lime in concentrated form, as a coarse, heavy precipitate is formed which settles very rapidly. When making more than one barrel of Bordeaux mixture, stock solutions of the raw materials are used. Stock solutions are prepared by weighing out a definite amount of each substance and then diluting them to a known volume. One hundred pounds of copper sulphate is dissolved and made up to 50 gallons. This is easiest done by placing the copper sulphate in a gunny bag or a coarse splint basket and suspending it near the surface of a barrel of water. The crystals will then dissolve overnight. If it is desired to hasten the process, use warm water. Each gallon of the stock solution now contains 2 pounds of copper sulphate. One hundred pounds of lime is slaked in a shallow box. Great care should be taken to neither drown nor burn the lime, as a lumpy milk of lime will result

in either case. Shovel this lime paste into a barrel and make up to 50 gallons. When thoroughly stirred, each gallon of lime stock solution now contains 2 pounds of lime. When making a barrel of Bordeaux mixture (4–4–50), take 2 gallons of copper sulphate stock solution (4 pounds copper sulphate) and 2 gallons of the well-stirred lime stock solution (4 pounds of lime) and dilute each several times. Pour the two solutions simultaneously through a strainer into the spray barrel and dilute to 50 gallons. The result is Bordeaux mixture. Where large quantities of Bordeaux mixture are to be used, a mixing platform should be arranged. It should be high enough so that the materials can be run into the spray tank by gravity. The floor of this platform should be large enough to accomodate from 4 to 6 50-gallon barrels. The stock solution barrels can be set to the rear of the platform and the dilution barrels near the front. The dilution barrels should each be equipped with spigots so that the solution can be run by gravity through a common trough into the spray tank. In making 100 gallons on this platform 4 gallons of copper sulphate stock solution are placed in one dilution barrel and 4 gallons of the lime stock solution in the second dilution barrel. The dilution barrels are then filled with water. The spigots on the dilution barrels are opened and the two materials run through the trough to the tank. As the two materials meet in the trough, 100 gallons of mixture are formed. A strainer is usually tacked over the end of the trough."

"NOTE.—Always handle and store the copper sulphate solution in wooden vessels."[1]

Potassium sulphide or liver of sulphur is employed as a weak fungicide for controlling some of our mildews, at a strength of 3 ounces to 10 gallons of water.

Combination Sprays.—It is often desirable to combat both insects and fungi with one application, and this is done by mixing a poison with a fungicide. One-quarter to one-half pound of Paris green, or 2 to 4 pounds of arsenate of lead, is combined with 50 gallons of Bordeaux mixture.

[1] Purdue Extension Leaflet No. 39.

Poisonous Effects of Spray Materials.—The question is often asked as to whether the spray materials applied to the portions of vegetables that are eaten are not injurious to the consumer. Chemical analyses and experience have proven that there is not sufficient poison present to have any deleterious effects. There is one exception to this statement, and that is with respect to spraying celery with Bordeaux mixture. If the plants are drenched and the liquid applied at a low pressure, sufficient quantities of the copper salt may collect on the stalks, especially at their bases, to cause injurious results. This difficulty can be overcome by applying the Bordeaux at a pressure of at least 150 pounds and stopping as soon as the leaves are thoroughly covered with a mist of the mixture. All stalks showing the green color from the Bordeaux should be carefully washed before using.

CHAPTER XI.

THE HOME VEGETABLE GARDEN.

In the previous chapters many suggestions have been made relative to the management of the home vegetable garden. It has been stated that the object of maintaining a home garden is to grow an adequate supply of a desired assortment of vegetables to provide the home table. In order to aid the gardener in attaining this end, general recommendations have been given concerning the most approved garden practises. In this chapter will be discussed the management of an experimental garden which was so planned and handled as to comply with the principles laid down in the earlier chapters of this book.

No two gardens will or should be handled in the same manner; yet the principles involved in managing one should hold for all others. In considering the plans and methods which follow, it should be clearly understood at the beginning that they are valuable chiefly as they deal with principles. The garden plan presented should not be copied, but should be modified to meet the conditions under which it is to be conducted. For instance, if horse cultivation is to be practised many of the rows must be placed farther apart. Under certain environmental conditions it may not be possible to make the garden twice as long as wide. Some families may require more of one kind of vegetable than will another. The varieties grown, although standard sorts, may not be the best for all localities and for all time. On the other hand, the companion and succession crops may be grown as given. The planting dates for the garden and hotbed may be followed quite closely. The point to be made is that the following information and methods are largely suggestive to the gardener, and will be valuable as a guide until a plan of management has been developed through two or three years' experience.

THE FARM GARDEN.[1]

In order to secure accurate information on the various garden operations, a vegetable garden designed to meet the needs of a farm family of five persons was planned and operated for three seasons. A detailed account was kept of every operation connected with this garden from the choosing of the location until all the crops had been harvested at the end of the third year. The ideas developed in the following pages had their origins in this three years' work, and indicate the results secured from actual performance. The data secured during the last year's work are herein given.

Location.—The garden was located on a moderately fertile, well-drained, black loam soil, about two feet deep, underlaid with gravel. The land sloped slightly toward the south. From a gardening stand-point the soil at the beginning of the work was very low in fertility, as it had been cropped heavily for several years without adequate fertilization.

Size.—The size chosen for the garden was 50 by 100 feet, as all of the work except plowing and harrowing was to be done with hand tools. Experience proved this to be large enough and after a few years of fertilization, this size could be materially reduced, and the same amount of vegetables produced.

Plan.—The planting plan for the third season is shown in Fig. 85. This plan is similar to the ones followed previously, although it embodies many minor improvements, indicated by the experience of the other years. This plan can probably be improved as a more thorough study of it is made, and as the land becomes more fertile. One-third of the garden space, exclusive of the row of asparagus, rhubarb, and herbs, was sown to red clover each season to add humus and nitrogen. By rotating the clover, each third of the garden was in clover every third year, leaving two-thirds for vegetables.

[1] Adapted from Bulletin No. 171, Purdue University Agr. Exp. Station.

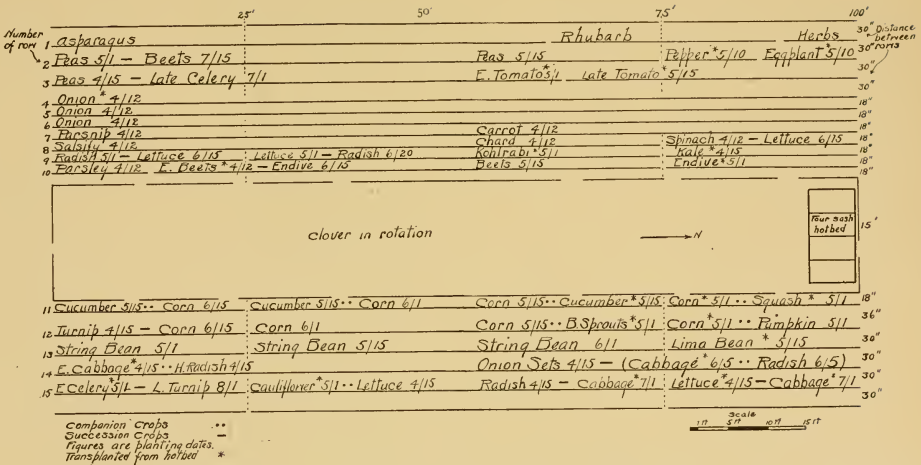

FIG. 85.—Planting plan of the vegetable garden. Size 50 x 100 feet, including the clover strip. A well-considered plan is one of the essentials of successful gardening. Make the plan in late winter, draw to scale on heavy paper and preserve for future use.

The rows ran north and south the long way of the garden to give the plants a more even distribution of light and to make less turning when cultivating.

In arranging the location of the vegetables, the perennials, such as rhubarb and asparagus, were placed along one side of the garden, as the land they occupied was not broken each season. Rows the same distance apart were placed together. The cucumber and squash were planted next to the clover plot in order to provide space for them to spread. Companion cropping (two crops grown together on the same land, as sweet corn and cucumber in row 11) and succession cropping (one crop following another the same season, as radish followed by lettuce in row 9) were practised whenever possible. In some rows three crops were grown in one season. In choosing companion and succession crops, vine or leaf crops followed root crops or *vice versa*, as they do not draw heavily on the same kinds of plant food.

FIG. 86.—Farm garden in early summer, showing the arrangements as indicated in Fig. 85. The strip of clover is shown in the centre with the hot-bed located at the opposite end.

The hot-bed was located at the north end of the clover strip, its position being changed from year to year as the clover was moved. With available space near the garden it might have been desirable to make a permanent hot-bed frame of bricks or grout outside the garden area and thus

have done away with digging a pit and setting the frame each season.

Rows 1 to 3 inclusive and 12 to 15 inclusive were 2½ feet apart, rows 4 to 10 inclusive were 18 inches apart, and row 11 was 3 feet distant from row 12. Successive sowings of such vegetables as pea, lettuce, corn, beet, and string bean were made about three weeks apart to provide a succession throughout the season. The dates of sowing the seed or setting plants into the garden follow each vegetable name on the plan. The plan as represented, including planting dates, was prepared in midwinter and was followed carefully throughout the season. The only deviations from the plan were the dates of planting, which were sometimes advanced a day or two on account of unfavorable weather conditions.

SEED SUPPLY.

Varieties.—Before selecting varieties, the kinds of vegetables to be grown were decided on. Those chosen are indicated on the garden plan. Most of the important vegetables were grown, including several which are not commonly found in the home garden. The unfamiliar ones were given a fair trial to determine whether some of them might not prove desirable.

Several factors influenced the selection of varieties. Quality, time required for maturing, adaptability to soil and season were all important considerations. Standard sorts of proven merit were always preferred to novelties. The varieties listed in Table IX were chosen with reference to these points and will be found to give excellent results. In some cases other varieties would be chosen on account of soil conditions, or the personal preference of the gardener. As new varieties of greater value are introduced some of these may be discarded.

Purchasing Seed.—As soon as the garden plan had been prepared and the kind and amount of each variety of vegetable decided, the seed were purchased. The amount and cost of the seed used in the experimental garden is given in Table X. The seed were bought by mail order in February

Table IX.—Variety and Distance between Plants Grown in Each Row.

Row.	Vegetable.	Variety.	Distance between plants.
1	Asparagus	Palmetto	2 ft.
	Rhubarb	Myatt's Victoria	3 ft.
	Herbs		
2	Pea	Thomas Laxton	drills
	Late beet	Detroit Dark Red	4 in.
	Pea	Thomas Laxton	drills
	Pepper	Ruby King	18 in.
	Egg plant	Black Beauty	24 in.
3	Pea	Thomas Laxton	drills
	Late celery	Golden Self-blanching	6 in.
	Early tomato	Earliana	30 in.
	Late tomato	Greater Baltimore	30 in.
4	Onion	Prizetaker	3 in.
5	Onion	Yellow Danvers	3 in.
6	Onion	Southport Red Globe	3 in.
7	Parsnip	Hollow Crown	4 in.
	Carrot	Golden Ball	3 in.
8	Salsify	Sandwich Island	4 in.
	Chard	Lucullus	10 in.
	Spinach	Victoria	4 in.
	Lettuce	Grand Rapids	drills
9	Radish	French Breakfast	drills
	Lettuce	Big Boston	10 in.
	Lettuce	Grand Rapids	drills
	Radish	White Icicle	½ in.
	Kohlrabi	White Vienna	9 in.
	Kale	Dwarf German	9 in.
10	Parsley	Moss Curled	6 in.
	Early beet	Eclipse	3 in.
	Endive	Green Curled	5 in.
	Beet	Eclipse	3 in.
	Endive	Green Curled	5 in.
11	Cucumber	White Spine	18 in. (hills)
	Sweet corn	Stowell's Evergreen	6 in. (drills)
	Sweet corn	Golden Bantam	18 in. (hills)
	Early squash	Summer Crookneck	18 in. (hills)
12	Early turnip	White Milan	6 in.
	Corn	Stowell's Evergreen	6 in. (drills)
	Corn	Golden Bantam	18 in. (hills)
	Brussels sprouts	Long Island Improved	18 in.
	Pumpkin	Sugar	18 in. (hills)
13	Bean	Burpee's Stringless Green Pod	3 in.
	Bean	Hodson Wax	3 in.
	Lima bean	Bush Lima	5 in.
14	Horseradish	Maliner Kren	18 in.
	Early cabbage	Early Jersey Wakefield	18 in.
	Onion sets	White	2 in.
	Late cabbage	Danish Ball Head	24 in.
	Radish	Long Scarlet Short Top	½ in.
15	Early celery	Golden Self-blanching	4 in.
	Late turnip	White Milan	5 in.
	Cauliflower	Dwarf Erfurt	18 in.
	Lettuce	Grand Rapids	drills
	Radish	French Breakfast	drills
	Late cabbage	Danish Ball Head	24 in.
	Late cabbage	Drumhead Savoy	24 in.
	Lettuce	Big Boston	10 in.

TABLE X.—AMOUNT AND COST OF VEGETABLE SEEDS NECESSARY FOR A GARDEN FIFTY BY ONE HUNDRED FEET IN SIZE.

Vegetable.	Variety.	Amount.	Cost.
Bean	Burpee's Stringless Green Pod	1 pkt.	$ .10
Bean	Hodson Wax	1 pkt.	.10
Bean	Burpee's Improved Bush Lima	2 pkts.	.30
Beet	Eclipse	2 pkts.	.10
Beet	Detroit Dark Red	2 pkts.	.20
Brussels sprouts	Long Island Improved	1 pkt.	.10
Cabbage	Early Jersey Wakefield	1 pkt.	.05
Cabbage	Danish Ball Head	1 pkt.	.05
Cabbage	Perfection Drumhead Savoy	1 pkt.	.05
Carrot	Golden Ball	1 pkt.	.10
Cauliflower	Early Dwarf Erfurt	1 pkt.	.10
Celery	Golden Self-blanching	1 pkt.	.10
Clover	Red	1 lb.	.15
Corn	Golden Bantam	1 qt.	.30
Corn	Stowell's Evergreen	1 qt.	.18
Cucumber	White Spine	1 pkt.	.10
Egg plant	Black Beauty	1 pkt.	.10
Endive	Green Curled	1 pkt.	.05
Horseradish	Maliner Kren	50 roots	.50
Kale	Dwarf German	1 pkt.	.05
Kohlrabi	Early White Vienna	1 pkt.	.05
Lettuce	Grand Rapids	2 pkts.	.10
Lettuce	Big Boston	2 pkts.	.10
Onion	Prizetaker	2 pkts.	.20
Onion	Southport Red Globe	2 pkts.	.10
Onion	Yellow Danvers	2 pkts.	.10
Onion sets	White	2 qts.	.30
Parsley	Dark Moss-curled	1 pkt.	.05
Parsnip	Hollow Crown	1 pkt.	.05
Pea	Thomas Laxton	3 pkts.	.30
Pepper	Ruby King	1 pkt.	.10
Pumpkin	Small Sugar	1 pkt.	.05
Radish	White Icicle	1 oz.	.07
Radish	French Breakfast	1 oz.	.07
Radish	Early Long Scarlet Short Top	1 oz.	.07
Radish	Cincinnati Market "Glass Radish"	1 oz.	.07
Salsify	Mammoth Sandwich Island	1 pkt.	.05
Spinach	Victoria	1 pkt.	.05
Squash	Golden Summer Crookneck	1 pkt.	.05
Swiss chard	Lucullus	1 pkt.	.10
Tomato	Sparks' Earliana	1 pkt.	.10
Tomato	Greater Baltimore	1 pkt.	.10
Turnip	White Milan	2 pkts.	.10
			$5.06
	Less 33⅓ per cent. discount on packets		1.11
	Total cost of seed		$3.95

TABLE XI.—THE PERCENTAGE OF GERMINATION OF THE VEGETABLE SEEDS PLANTED.

Vegetable.	Variety.	Duration of test.	Germination, per cent.
Bean	Burpee's Stringless Green Pod	7 days	45.5
Bean	Hodson Wax	7 days	36.
Bean	Burpee's Improved Bush Lima	7 days	70.
Bean	Burpee's Improved Bush Lima	5 days	95.
Beet	Eclipse	8 days	63.5
Beet	Detroit Dark Red	8 days	78.5
Beet	Detroit Dark Red	8 days	83.5
Beet	Eclipse	7 days	75. (balls)
Brussels sprouts	Long Island Improved	5 days	80.5
Cabbage	Perfection Drumhead Savoy	6 days	73.
Cabbage	Early Jersey Wakefield	5 days	93.5
Cabbage	Danish Ball Head	6 days	90.
Carrot	Golden Ball	12 days	76.
Cauliflower	Early Dwarf Erfurt	5 days	77.5
Celery	Golden Self-blanching	14 days	58.25
Chard	Lucullus	8 days	67.
Corn	Golden Bantam	5 days	95.5
Corn	Stowell's Evergreen	7 days	67.
Cucumber	White Spine	5 days	85.
Egg plant	Black Beauty	7 days	88.5
Endive	Green Curled	7 days	90.
Kale	Dwarf German	6 days	82.5
Kohlrabi	Early White Vienna	5 days	91.
Lettuce	Grand Rapids	5 days	97.
Lettuce	Big Boston	6 days	83.5
Lettuce	Big Boston	6 days	97.5
Lettuce	Grand Rapids	3 days	98.
Lettuce	Grand Rapids	3 days	99.5
Onion	Prizetaker	7 days	95.5
Onion	Prizetaker	7 days	96.
Onion	Yellow Danvers	7 days	97.
Onion	Yellow Danvers	7 days	97.5
Parsley	Dark Moss-curled	30 days	70.
Parsnip	Hollow Crown	12 days	74.5
Pea	Thomas Laxton	6 days	100.
Pepper	Ruby King	7 days	13.5
Pumpkin	Small Sugar	6 days	95.
Radish	French Breakfast	5 days	98.5
Radish	Early Long Scarlet Short Top	5 days	99.5
Radish	Cincinnati Market, "Glass Radish"	5 days	98.5
Radish	White Icicle	5 days	59.
Salsify	Mammoth Sandwich Island	10 days	85.
Spinach	Victoria	10 days	76.
Squash	Golden Summer Crookneck	5 days	74.
Tomato	Greater Baltimore	7 days	93.5
Tomato	Sparks' Earliana	7 days	83.
Turnip	White Milan	6 days	90.
Turnip	White Milan	6 days	79.5

from a reliable firm. With the aid of the garden plan and a seed catalog the order was made out and placed at the above time to insure the seeds being on hand when needed. Only the best grades were purchased.

The viability of the seed was determined by a germination test. This consisted in counting out a certain number of seeds (25 to 100, depending on the size), and placing them under conditions favorable for germination. Two moist blotters between two plates made a good germinator. The promptness and total percentage of germination were determined by a daily inspection. Table XI gives the germination data for the seeds used, which are about what should be expected of good seed.

HOT-BEDS.

With the aid of the hot-bed the season of some vegetables was lengthened, some were produced quite out of their natural season, and superior plants for setting were grown for garden use. Care and attention to details enabled the operator to manage the hot-bed with excellent results.

The dimensions of the hot-bed selected as most suitable were 6 x 12 feet. This bed took four standard size 3 x 6 sash. A planting plan of this bed is shown in Fig. 87. It will be seen that one sash was sown to radish and another to lettuce, both of which matured in the hot-bed and were ready to use three or four weeks earlier than they could have been grown in the open ground. A third sash was used for starting tomato, cabbage, etc., to be set out later when the season was sufficiently advanced. The remaining bed was used for starting cucumber and squash in dirt bands and as a place to store other plants that were transplanted into dirt bands from the hot-bed soil in which the seed had been sown. If only enough space had been wanted to start plants to set in the garden a two-sash hot-bed (6 x 6 feet) would have been of ample size. The vegetable season was lengthened several weeks, however, by the use of the extra sash for early spring (see Figs. 85 and 87) and late fall growing of lettuce and radish.

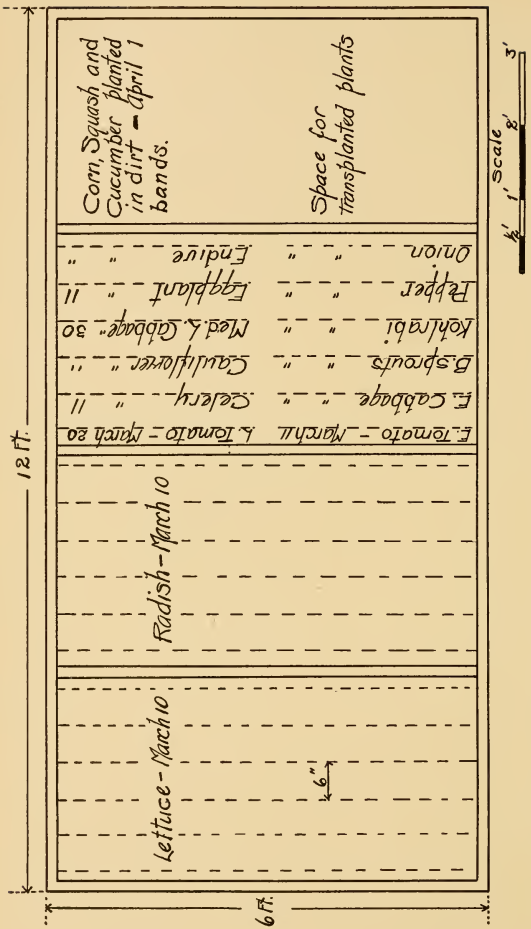

FIG. 87.—Planting plan of the four sash hot-bed. The radish and lettuce matured in the bed and supplied the table early in the season. As the vegetables under the third sash were transplanted into dirt bands they were transferred to the vacant space under the fourth sash.

Construction.—The hot-bed consisted of three parts: the pit, frame, and cover. The pit for the four-sash bed was 12 feet long, 6 feet wide, and 2 feet deep. It was dug in the fall before the ground froze, and then filled with straw to protect it during the winter. The pit might have been dug just before the bed was started in the spring, although this would have been difficult when the ground was frozen. The frame was made of 2-inch cypress. The back board was 16 inches high and the front board 10 inches high, beveled so that the sash fitted snugly. The two end pieces were 6 feet long, 16 inches wide at one end, and 10 inches wide at the other end. The corners were fastened with strips of strap iron bent to a right angle and bolted on, thus allowing the frame to be taken down and stored through the winter. The construction of the frame allowed the sash to slope to the south, the north side being 6 inches the higher, permitting the sun's rays to pass through the glass less obliquely and allowing rains to run off quickly.

In each corner of the pit a 2 x 4 was driven to stiffen the frame and hold it in place. The bottom of the frame was placed just below the soil level and after fastening, dirt was packed around it outside.

Double-glass sash were used, as they do not require the extra covering. Canvas- or muslin-covered sash might have been used in late April and May, but would not have been safe during March. It was essential that the hot-bed be started by March 1 in order to grow a long succession of vegetables.

Heating Material.—Artificial heat must be provided during March and April, as the sun's rays are not warm enough at this season to keep the temperature high and constant. The heat for the four-sash hot-bed was provided by using fermenting horse manure handled as follows: The manure was gathered fresh from the stable, mixed with about one-third its bulk of litter, and piled under a shed where it was allowed to heat. On the third day it was forked over and allowed to heat again. The turning was repeated on the fifth day. The manure was placed in the hot-bed pit on the eighth day, at which time it was fermenting thoroughly and giving off considerable heat. It was placed in the pit in layers 6 to

8 inches deep and each layer was firmed by tramping. Care was taken to keep the sides and corners well filled to prevent settling after the soil had been added. The bed was filled with manure up to the level of the south side of the frame. Four wagon loads of manure were required for filling the hot-bed pit and 6 inches of the frame which made the space to be filled 2 x 6 x 12 feet in size.

Soil.—The hot-bed soil should be well supplied with plant food and rather loose to prevent baking after watering. In this work a composted soil was employed for this purpose. This was prepared by piling up alternate layers of blue grass sod and barnyard manure in the open six to eight months before it was to be used. This material when rotted was screened to remove the rougher parts and a loose, rich loam was left well adapted to hot-bed work. Six inches of the soil was put on top of the manure in the hot-bed, the weight of which caused the heating material to settle several inches.

Sowing Seed.—As soon as the soil was in place the sash were put on the frame and the whole bed allowed to heat. By examining Table XII, the temperatures within and without the hot-bed can be compared and the large amount of heat given off by the fermenting manure noted. From March 1 to 6 the temperature in the bed ranged from 30° to 123° F. There was a gradual rise until March 8, after which the temperature began to drop.

No seed were sown until after the manure had passed through the first heating, as the temperature rose to such a degree that the seedlings would have been killed. The first seed were sown March 10 (see Fig. 87), when the temperature had dropped to 92° F. Table XIII gives the sowing dates. The rows across the hot-bed were 6 inches apart and the seed were drilled in the rows by hand.

Ventilating.—The hot-beds were ventilated in cool weather by lifting the sash on the north side and in warm weather by partially or entirely removing them. Tomato, pepper, egg plant, and other warm-weather plants thrived best at a day temperature of from 70° to 80° F. Radish, lettuce, onion, cabbage, and others of this class preferred a tempera-

TABLE XII.—OUTSIDE TEMPERATURE AND TEMPERATURE IN THE HOT-BED FROM MARCH 1 TO APRIL 30.

Date.	7.00 A.M. Outside.	7.00 A.M. Hot-bed.	12.00 P.M. Outside.	12.00 P.M. Hot-bed.	5.00 P.M. Outside.	5.00 P.M. Hot-bed.
March 1	18° F.	30° F.	26° F.	60° F.	22° F.	42° F.
March 2	12° F.	38° F.	26° F.	46° F.	22° F.	57° F.
March 3	18° F.	62° F.	26° F.	62° F.	22° F.	94° F.
March 4	16° F.	97° F.	31° F.	110° F.	25° F.	102° F.
March 5	14° F.	104° F.	29° F.	104° F.	25° F.	102° F.
March 6	12° F.	104° F.	34° F.	123° F.	32° F.	114° F.
March 7	22° F.	105° F.	32° F.	96° F.	33° F.	96° F.
March 8	30° F.	104° F.	35° F.	106° F.	32° F.	100° F.
March 9	13° F.	93° F.	26° F.	95° F.	26° F.	90° F.
March 10	12° F.	89° F.	38° F.	92° F.	30° F.	92° F.
March 11	29° F.	92° F.	33° F.	92° F.	34° F.	92° F.
March 12	33° F.	99° F.	36° F.	88° F.	34° F.	84° F.
March 13	24° F.	73° F.	40° F.	86° F.	32° F.	87° F.
March 14	33° F.	82° F.	48° F.	73° F.	37° F.	82° F.
March 15	33° F.	96° F.	36° F.	92° F.	28° F.	72° F.
March 16	26° F.	58° F.	46° F.	72° F.	43° F.	70° F.
March 17	37° F.	69° F.	60° F.	72° F.	48° F.	72° F.
March 18	37° F.	80° F.	53° F.	78° F.	53° F.	79° F.
March 19	44° F.	79° F.	58° F.	82° F.	47° F.	74° F.
March 20	30° F.	60° F.	31° F.	67° F.	30° F.	69° F.
March 21	24° F.	70° F.	28° F.	74° F.	30° F.	72° F.
March 22	22° F.	64° F.	32° F.	84° F.	32° F.	74° F.
March 23	30° F.	72° F.	41° F.	74° F.	37° F.	71° F.
March 24	30° F.	78° F.	32° F.	80° F.	30° F.	76° F.
March 25	26° F.	68° F.	44° F.	78° F.	38° F.	68° F.
March 26	36° F.	72° F.	52° F.	84° F.	46° F.	80° F.
March 27	34° F.	75° F.	42° F.	70° F.	40° F.	68° F.
March 28	36° F.	68° F.	46° F.	68° F.	44° F.	67° F.
March 29	40° F.	62° F.	48° F.	82° F.	40° F.	62° F.
March 30	32° F.	63° F.	54° F.	78° F.	58° F.	70° F.
March 31	45° F.	60° F.	66° F.	76° F.	67° F.	70° F.
April 1	44° F.	62° F.	56° F.	60° F.	42° F.	58° F.
April 2	34° F.	56° F.	38° F.	60° F.	42° F.	60° F.
April 3	33° F.	57° F.	50° F.	68° F.	48° F.	62° F.
April 4	48° F.	56° F.	70° F.	84° F.	66° F.	70° F.
April 5	58° F.	60° F.	70° F.	76° F.	68° F.	68° F.
April 6	58° F.	60° F.	72° F.	73° F.	66° F.	70° F.
April 7	38° F.	56° F.	50° F.	66° F.	45° F.	65° F.
April 8	48° F.	54° F.	62° F.	78° F.	56° F.	70° F.
April 9	48° F.	56° F.	68° F.	85° F.	61° F.	62° F.
April 10	52° F.	60° F.	70° F.	85° F.	68° F.	76° F.
April 11	62° F.	62° F.	80° F.	84° F.	72° F.	76° F.
April 12	64° F.	64° F.	83° F.	86° F.	58° F.	70° F.
April 13	52° F.	70° F.	64° F.	82° F.	60° F.	68° F.
April 14	62° F.	67° F.	76° F.	80° F.	72° F.	72° F.
April 15	58° F.	62° F.	76° F.	80° F.	71° F.	74° F.
April 16	54° F.	66° F.	66° F.	83° F.	67° F.	76° F.
April 17	42° F.	60° F.	42° F.	57° F.	41° F.	54° F.
April 18	36° F.	54° F.	38° F.	57° F.	38° F.	56° F.
April 19	40° F.	52° F.	56° F.	70° F.	57° F.	64° F.
April 20	48° F.	62° F.	64° F.	67° F.	60° F.	60° F.
April 21	54° F.	57° F.	66° F.	66° F.	64° F.	64° F.
April 22	50° F.	58° F.	47° F.	58° F.	47° F.	60° F.
April 23	49° F.	56° F.	64° F.	60° F.	64° F.	68° F.
April 24	60° F.	61° F.	70° F.	86° F.	62° F.	72° F.
April 25	58° F.	58° F.	73° F.	75° F.	64° F.	63° F.
April 26	57° F.	60° F.	62° F.	62° F.	63° F.	65° F.
April 27	48° F.	54° F.	60° F.	88° F.	56° F.	66° F.
April 28	48° F.	60° F.	45° F.	52° F.	52° F.	56° F.
April 29	58° F.	62° F.	46° F.	52° F.	45° F.	51° F.
April 30	48° F.	51° F.	56° F.	70° F.	61° F.	63° F.

TABLE XIII.—SPACE OCCUPIED, DATES OF SOWING, TRANSPLANTING AND SETTING OF VEGETABLES STARTED IN THE HOT-BED.

Vegetables.	Variety.	Space occupied.	Seed sown in hot-bed.	Transplanted into dirt bands.	Set in garden.
Early tomato	Sparks' Earliana	3 feet	March 11	April 6	May 1
Late tomato	Greater Baltimore	3 feet	March 20	April 10	May 15
Early cabbage	Early Jersey Wakefield	3 feet	March 11	April 6	April 15
Early celery	Golden Self-blanching	3 feet	March 11	April 6	May 1
Brussels sprouts	Long Island Improved	3 feet	March 11	April 6	May 1
Cauliflower	Dwarf Erfurt	3 feet	March 11	April 6	May 1
Kohlrabi	White Vienna	3 feet	March 11	April 6	May 1
Cabbage	Danish Ball Head	3 feet	March 30	April 15	June 5
Pepper	Ruby King	3 feet	March 11	April 6	May 10
Egg plant	Black Beauty	3 feet	March 11	April 6	May 10
Onion	Prizetaker	3 feet	March 11	April 6	April 12
Endive	Green Curled	3 feet	March 11	April 6	May 1
Corn	Golden Bantam	35 pots	April 1	Sown in dirt bands	May 1
Early squash	Crookneck	12 pots	April 1	Sown in dirt bands	May 1
Cucumber	White Spine	30 pots	April 1	Sown in dirt bands	May 15
Radish	Cincinnati Market	One sash	Matured in hot-bed		
Lettuce	Grand Rapids	5 rows	Matured in hot-bed		
Lettuce	Big Boston	1 row	Matured in hot-bed		

ture of 55° to 65° F. With these two classes growing in the same bed a temperature of about 70° proved most satisfactory, and it was the aim of the gardener to hold this temperature uniform by manipulating the sash on the beds. This required considerable attention on days of alternate bright sunshine and cloudiness. When the outside air was chilly and damp, draughts were not permitted to strike the plants, as they would check growth and induce disease. A couple of weeks before the plants were set in the garden the sash were removed partially or entirely, if the weather permitted, to harden off the plants and accustom them to outside conditions.

Watering.—The amount of water used in the hot-bed depended largely upon the amount of sunshine and the season of the year. In March a moderate amount applied every ten days or two weeks was usually sufficient, as evaporation was slight. In the latter part of April, when warm and sunshiny, the bed required thorough watering each day.

In cool weather water was applied in the morning so that it would be warmed during the day and so that the plants would be dry when night came and the temperature dropped. During warm or hot weather watering at night was practised. It was sometimes advisable to take the chill from cold water before using by placing it over a fire for a short time. A watering can with a fine rose sprinkler proved most satisfactory for applying the water, although it was applied through a hose during mild weather.

Seed Bed.—Celery and cabbage plants for late plantings were started in a seed bed in the open ground. The seed was sown May 20 and the plants were sufficiently large for setting in the garden by July 1.

Transplanting.—The transplanting was usually done when the first true leaves began to form, generally about three weeks after sowing the seed, and when the plants were $1\frac{1}{2}$ or $2\frac{1}{2}$ inches high.

The plants were set in flats, earthen pots, or dirt bands. The flats were 15 inches wide, 20 inches long, and 3 inches deep inside measurements. These were filled with composted soil or rich garden loam and then the plants set in $1\frac{1}{2}$ or 2

inches apart. Earthen pots and dirt bands 3 or 4 inches in diameter were also used. One plant was set in each band and when removed to the garden the soil, band, and plant were all taken and set. When the pot was used the ball of earth was removed with the plant and set, and likewise with the flat a ball of earth was taken with each individual plant.

MANAGEMENT.

Fertilizing.—The fertility of the soil to be used for gardening purposes is an important consideration. In order to produce high quality vegetables in the shortest time a sufficient amount of available plant food must be present in the soil. This condition was obtained by the use of well-rotted stable manure and commercial fertilizers. Stable manure at the rate of 20 tons to the acre was applied as a top dressing in the spring before plowing. After the garden had been plowed an application of 1000 pounds to the acre of commercial fertilizer was made, testing 2.5 to 4 per cent. available nitrogen, 8 to 10 per cent. phosphoric acid, and 6 to 8 per cent. potash. The land was then harrowed until the fertilizer was thoroughly mixed with the soil to prevent burning of seedling plants just after germination. With leaf crops like lettuce and spinach it was often advisable to open a shallow trench 3 or 4 inches away from the row, apply sodium nitrate, and then cover it with soil. Plants set in hills, such as the tomato, also responded profitably to the above-mentioned complete fertilizer when a handful was scattered around the hill a couple of weeks after the plants had been set.

Fitting.—Spring plowing was practised in order that the soil would be in fine tilth to a good depth when the seed was sown. The garden was plowed to a good depth, 8 to 10 inches being a fair average. The harrow followed and the land was worked until perfectly level. On the suburban or city garden, or this farm garden, the spading fork may be sub-substituted for the plow and the garden rake for the harrow. Although slower than horse tools, with a little care, as good a seed-bed can be made with these hand tools.

After the harrowing had been completed the soil where seed was to be immediately sown was worked down with the garden rake and all clods or rough material on the surface removed.

Laying Out.—The staking out of the garden was a simple matter after the planting plan had been prepared. A permanent stake was driven at each end of the rows to which was attached the garden line when sowing seed. By stretching a tape line across the ends of the garden and then following the plan as a guide, the proper location of the stakes was quickly determined and the stakes set. The straightness and neatness of the rows counted for much in the home garden, and extra time spent in laying out meant greater ease in handling.

Sowing Seed.—The vegetable seed were sown by hand. Only small quantities of seed were sown at a time and this was done quickly by making a shallow trench along the garden line with a sharp stick or the end of a hoe handle and then drilling the seed from between the fingers and covering it with a hoe or rake.

The depth of planting depended upon the size of the seed and the season. Small seed such as lettuce and radish were sown from $\frac{1}{2}$ to $\frac{3}{4}$ of an inch deep and pea and corn 2 inches deep. Early in the season, when the ground was cold and damp, the seed were planted shallow, while later they were planted somewhat deeper.

In sowing seed a slightly larger amount was sown than the germination test indicated was needed. This improved the chance for a good stand, and if the plants came too thick they were thinned later.

The dates of sowing the various vegetables are given on the garden plan. Where succession crops were planted, the soil along the row was spaded and raked until in first-class shape before the second crop was sown.

The part left for clover rotation was sown about May 1 each season. The land was thoroughly fitted, the seed sown broadcast and raked in with a garden rake. The clover grew luxuriantly and a fine stand was secured each of the three seasons with this treatment.

Thinning.—It has been previously mentioned that a larger amount of seed was sown than just enough to produce the desired number of plants. This was done to insure a good stand and in a majority of cases more plants grew than were actually wanted, which made thinning necessary. This practice resolved itself into a process of selection. The weakest plants were discarded and only the most vigorous left to mature. With such vegetables as radish, lettuce, and early beet the plants were left until edible and then the thinning was done, as more space was needed. With all other kinds, the thinning was done early before there was any danger of stunting those that were to remain. Since thinning is tedious it was found advisable to distribute uniformly the proper amount of seed as nearly as possible when sowing.

Setting.—With plants started or transplanted into pots or dirt bands in the hot-bed, the only thing of importance to be considered in resetting in the garden was the probable temperature for the first couple of weeks following this operation. Cabbage, lettuce, cauliflower, and kohlrabi will withstand quite cool weather in the open, while tomato, egg plant, and pepper should not be set until the weather has become settled and warm. By consulting Table XIV the last date of probable frosts in spring was approximately determined for LaFayette, and this date used as a guide in setting the warm weather plants. The dates given on the planting plan will prove satisfactory in regions similar to LaFayette.

For a few days previous to transferring the young plants from the hot-bed to the garden, they were given little or no water, and then just before setting they were wet down thoroughly. When set the soil around the roots was taken with the plant and the whole set a little deeper than the soil level in an opening made with a trowel or dibble. The plants were properly grown and, consequently, watering after setting was not necessary nor did it make much difference as to the kind or time of day that the plants were set. The ball of earth around the root system protected the plant so that the change had little or no effect. If the plants had

TABLE XIV.—KILLING FROSTS—AVERAGE DATES FOR INDIANA STATIONS FROM 1903 TO 1912 INCLUSIVE, COMPILED FROM ANNUAL SUMMARIES OF THE CLIMATOLOGICAL SERVICE OF THE WEATHER BUREAU, U. S. DEPARTMENT OF AGRICULTURE. SAME INFORMATION IS AVAILABLE FOR ALL OTHER STATES.

Stations.	Last in spring.	First in autumn.
Anderson	May 4	Oct. 9
Auburn	May 10	Oct. 5
Bloomington	April 26	Oct. 17
Bluffton	May 6	Oct. 6
Butlerville	May 2	Oct. 15
Cambridge City	May 8	Oct. 12
Columbus	May 4	Oct. 14
Connersville	May 7	Oct. 15
Delphi	May 6	Oct. 4
Evansville	April 5	Oct. 25
Farmersburg	April 19	Oct. 19
Farmland	April 28	Oct. 15
Fort Wayne	May 10	Oct. 12
Greensburg	April 28	Oct. 14
Hammond	April 30	Oct. 18
Huntington	May 7	Oct. 10
Indianapolis	April 16	Oct. 18
Jeffersonville	April 13	Oct. 19
Kokomo	May 7	Oct. 6
LaFayette	May 4	Oct. 11
La Porte	May 5	Oct. 11
Logansport	May 6	Oct. 11
Madison	April 24	Oct. 19
Marengo	April 27	Oct. 10
Marion	May 8	Oct. 8
Mauzy	May 7	Oct. 9
Moores Hill	April 30	Oct. 16
Mt. Vernon	April 15	Oct. 20
Paoli	April 28	Oct. 13
Princeton	April 23	Oct. 19
Richmond	May 9	Oct. 7
Rockville	April 27	Oct. 11
Rome	April 19	Oct. 17
Salem	April 30	Oct. 9
Scottsburg	April 11	Oct. 17
Shelbyville	April 23	Oct. 10
South Bend	May 2	Oct. 14
Terre Haute	April 10	Oct. 20
Veedersburg	May 4	Oct. 11
Vevay	April 25	Oct. 22
Vincennes	April 13	Oct. 19
Washington	April 17	Oct. 19
Worthington	April 27	Oct. 12

TABLE XV.—KIND, AMOUNT AND COST OF LABOR NECESSARY FOR MANAGING A HOME GARDEN FIFTY BY ONE HUNDRED FEET IN SIZE.

Date.	Kind.	Amount.	Cost.
Nov. 24	Hauling manure	6 hours	$2.40
Feb. 2	Placing boxes on rhubarb	2 hours	.35
Apr. 6	Cultivating, fertilizing asparagus	1 hour	.17½
Apr. 9	Disking garden twice	1 hour	.40
Apr. 10	Plowing garden	1 hour	.40
Apr. 10	Harrowing, floating	2 hours	.80
Apr. 11	Applying commercial fertilizer	1½ hours	.25
Apr. 12	Harrowing	½ hour	.20
Apr. 12	Staking out	4 hours	.70
Apr. 12	Sowing seed	8 hours	1.40
Apr. 15	Baking, cultivating	4 hours	.70
Apr. 15	Transplanting from hot-bed	4 hours	.70
	Sowing seed	2 hours	.35
Apr. 20	Cultivating asparagus, rhubarb	1 hour	.17½
Apr. 25	Hoeing	2 hours	.35
May 1	Sowing seed	4 hours	.70
May 1	Hoeing	3 hours	.52
May 1	Transplanting	4 hours	.70
May 7	Cultivating	4 hours	.70
May 11	Cultivating	2 hours	.35
May 15	Sowing seed	1 hour	.17½
May 20	Cultivating	2 hours	.35
May 25	Cultivating	2 hours	.35
June 1	Sowing seed	2 hours	.35
June 1	Cultivating	1 hour	.17½
June 5	Sowing seed, setting plants	1 hour	.17½
June 11	Cultivating	1 hour	.17½
June 13	Hoeing	1 hour	.17½
June 15	Sowing seed	1 hour	.17½
June 20	Cultivating	1 hour	.17½
June 27	Cultivating, hoeing	2 hours	.35
July 1	Setting plants	1 hour	.17½
July 11	Cultivating	2 hours	.35
July 12	Staking tomatoes	1 hour	.17½
July 20	Cultivating	½ hour	.09
July 29	Cultivating	½ hour	.09
Aug. 1	Sowing seed	½ hour	.09
Aug. 8	Cultivating	1 hour	.17½
Aug. 16	Cultivating, hoeing	1 hour	.17½
Aug. 28	Cultivating, hoeing	1 hour	.17½
Sept. 10	Cultivating, hoeing	1 hour	.17½
	Total	81.5 hours	$16.61

been pulled loose from the soil it would have been necessary to water and to plant in the evening or on cloudy days and even then many might have perished.

In setting the plant was placed firmly in the soil and cultivation followed immediately to loosen the packed surface.

Cultivation.—When properly handled an average of four hours per week was found to be ample to keep a garden 50 by 100 feet in excellent condition. The garden was cultivated easily in from twenty-five to thirty minutes with a wheel hoe, and three cultivations per week were generally sufficient for securing good results. This made a total of one and a half hours per week for cultivation and left a remainder of two and one-half hours for hand weeding and other garden operations.

The necessary tools for cultivating the garden were the hoe, rake, and two-wheel hand cultivator. The garden rake proved a very handy and rapid tool to use in breaking soil crust and to provide a dust mulch. The hoe and hand cultivator were used when the soil needed loosening and if the cultivator was skilfully handled but little hoeing was necessary.

The date and number of cultivations given depended largely upon the season, and are given in Table XV.

TABLE XVI.—KIND, AMOUNT AND COST OF LABOR NECESSARY FOR MANAGING A FOUR-SASH HOT-BED (6 x 12 FEET).

Date.	Kind.	Amount.	Cost.
Nov. 24	Digging pit	10 hours	$1.75
Feb. 23	Drawing four loads of manure	6 hours	2.70
Feb. 26	Turning manure	2 hours	.35
Feb. 28	Setting hot-bed frame	2 hours	.35
Feb. 28	Turning manure	2 hours	.35
Mar. 1	Placing manure in pit	6 hours	1.05
Mar. 1	Placing soil in bed	4 hours	.70
Mar. 10	Sowing seed	½ hour	.09
Mar. 11	Sowing seed	1 hour	.17½
Mar. 24	Cultivating	1 hour	.17½
Apr. 1	Sowing seed	1 hour	.17½
Apr. 6	Transplanting	2 hours	.35
Apr. 15	Cultivating	1 hour	.17½
Mar. 1 – Apr. 15	Watering, ventilating	20 hours	3.50
	Total	58½ hours	$11.89

TABLE XVII.—LOCATION, DATE OF SOWING, PICKING SEASON, WEIGHT AND VALUE OF VEGETABLES SECURED FROM THE GARDEN.

Row.	Vegetable.	Variety.	Space occupied.	Sowed or set.	Picking season.	Weight.	Value.
1	Asparagus	Palmetto	1st 60 feet	. . .	May 3–June 22	16½ pounds	$1.60
1	Rhubarb	Victoria	40 feet	. . .	April 25–May 17	102 pounds	3.25
2	Pea	Thomas Laxton	1st 50 feet	May 1	June 27–July 9	9 pounds	.45
2	Pepper	Ruby King	7th 12½ feet	May 10	Aug. 2–Oct. 5	5 pounds	.50
2	Egg plant	Black Beauty	8th 12½ feet	May 10	Oct. 5	12 pounds	.60
2	Pea	Thomas Laxton	3d 25 feet	May 15	July 3–July 15	4¾ pounds	.20
2	Late beet	Detroit Dark Red	1st 50 feet	July 15	Oct. 17	90 pounds	1.25
3	Pea	Thomas Laxton	1st 50 feet	April 15	June 16–July 1	26 pounds	1.25
3	Celery	Golden Self-blanching	1st 50 feet	July 1	Oct. 17	32 pounds	1.50
3	Tomato	Earliana	5th 12½ feet	May 1	July 9–Oct. 2	70½ pounds	4.04
3	Tomato	Greater Baltimore	Last 37½ feet	May 15	July 17–Oct. 2	256¾ pounds	4.12
4	Onion	Prizetaker	100 feet	April 12	Aug. 2–Sept. 12	60¾ pounds	1.45
5	Onion	Yellow Danvers	100 feet	April 12	Sept. 24	62 pounds	1.50
6	Onion	South Port Red Globe	100 feet	April 12	July 6–Sept. 12	58½ pounds	1.28
7	Parsnip	Hollow Crown	1st 50 feet	April 12	Oct. 17	44½ pounds	1.00
7	Carrot	Golden Ball	2d 50 feet	April 12	Oct. 5	104¼ pounds	1.05
8	Salsify	Sandwich Island	1st 50 feet	April 12	Oct. 17	13 pounds	1.00
8	Spinach	Victoria	4th 25 feet	April 12	June 1–June 15	22 pounds	2.20
8	Lettuce	Grand Rapids	4th 25 feet	June 15	Aug. 10–Aug. 28	28 pounds	1.20
8	Swiss chard	Lucullus	3d 25 feet	April 12	July 20–Oct. 2	93½ pounds	1.65
9	Kohlrabi	White Vienna	3d 25 feet	May 1	June 15–Sept. 20	17 pounds	.50
9	Radish	French Breakfast	1st 25 feet	May 1	June 5–June 15	35 pounds	.45
9	Kale	Dwarf German	4th 25 feet	April 15	June 13–Oct. 2	35 pounds	1.70
9	Radish	Icicle	2d 25 feet	June 20	July 28–Aug. 10	18½ pounds	.25
9	Lettuce	Big Boston	1st 25 feet	June 15	July 21–Aug. 29	21½ pounds	.65
9	Lettuce	Grand Rapids	2d 25 feet	May 1	June 10–June 29	18¼ pounds	.90
10	Parsley	Dark Moss Curled	1st 12½ feet	April 12	July 1–Oct. 17	9¼ pounds	1.00
10	Beet	Eclipse	2d 12½ feet 2d 25 feet	April 12	June 1–June 15	47¼ pounds	.40
10	Beet	Eclipse	3d 25 feet	May 15	Aug. 20–Sept. 9	27¼ pounds	.75
10	Endive	Green Curled	Last 25 feet	May 1	July 8	14½ pounds	.75
10	Endive	Green Curled	2d 12½ feet 2d 25 feet	June 15	Sept. 10–Oct. 20	18 pounds	.88

11	Sweet corn	Golden Bantam	4th 25 feet	May 1	July 10–Aug. 2	26¼ pounds	1.00
11	Sweet corn	Golden Bantam	3d 25 feet	May 15	July 25–Aug. 8	23¼ pounds	.75
11	Sweet corn	Stowell's Evergreen	1st 25 feet	June 15	Sept. 12–Sept. 20	19 pounds	.25
11	Sweet corn	Golden Bantam	2d 25 feet	June 1	Aug. 17–Aug. 25	23 pounds	.70
11	Cucumber	White Spine	1st 75 feet	May 15	July 24–Aug. 28	60 pounds	1.50
11	Early squash	Summer Crookneck	Last 25 feet	May 1	June 13–Sept. 12	53½ pounds	1.73
12	Sweet corn	Golden Bantam	4th 25 feet	May 1	July 12–Aug. 2	17 pounds	.68
12	Sweet corn	Stowell's Evergreen	1st 25 feet	June 15	Sept. 2–Sept. 8	16 pounds	.60
12	Sweet corn	Golden Bantam	3d 25 feet	May 15	July 23–Aug. 6	26½ pounds	1.15
12	Sweet corn	Golden Bantam	2d 25 feet	June 1	Aug. 18–Aug. 25	18½ pounds	.60
12	Turnip	White Milan	1st 25 feet	April 15	June 11–July 10	36½ pounds	.70
12	Brussels sprouts	Long Island Improved	3d 25 feet	May 1	Aug. 15–Sept. 12	6 pounds	.50
12	Pumpkin	Small Sugar	4th 25 feet	May 1	Aug. 8–Sept. 12	14 pounds	.45
13	Bean	Burpee's Stringless Green Pod	3d 25 feet	June 1	Aug. 20–Sept. 10	22 pounds	1.00
13	Bean	Hodson Wax	2d 25 feet	May 15	July 22–Aug. 12	24¾ pounds	.85
13	Bean	Bush Lima	4th 25 feet	May 15	Aug. 2–Aug. 5	6 pounds	.30
13	Bean	Burpee's Stringless Green Pod	1st 25 feet	May 1	June 25–July 26	19½ pounds	.89
14	Horseradish	Maliner Kren	1st 50 feet	April 15	Oct. 17	13¼ pounds	.75
14	Cabbage	Early Jersey Wakefield	1st 50 feet	April 15	June 28–Aug. 2	48 pounds	1.69
14	Onion	White Sets	2d 50 feet	April 15	May 17–June 5	20½ pounds	1.62
14	Cabbage	Danish Ball Head	2d 50 feet	June 5	Sept. 21–Sept. 30	50 pounds	1.50
14	Radish	Long Scarlet Short Top	2d 50 feet	June 5	July 10–Aug. 1	21¾ pounds	.85
15	Radish	French Breakfast	3d 25 feet	April 15	May 16–June 3	9½ pounds	.77
15	Cauliflower	Early Dwarf Erfurt	2d 25 feet	May 1	July 20–July 26	6 pounds	.40
15	Lettuce	Grand Rapids	2d 25 feet	April 15	June 1–June 16	20 pounds	1.00
15	Cabbage	Savoy	3d 25 feet	July 1	Sept. 26–Oct. 10	33 pounds	.75
15	Cabbage	Danish Ball Head	4th 25 feet	July 1	Sept. 25–Oct. 10	29 pounds	.70
15	Lettuce	Big Boston	4th 25 feet	April 15	June 10–June 22	22 pounds	1.05
15	Celery	Golden Self-blanching	1st 25 feet	May 1	July 18–Aug. 1	13½ pounds	.70
15	Turnip	White Milan	1st 25 feet	Aug. 1	Oct. 10	50 pounds	.50
					Total	2120¾ pounds	$65.25

COSTS AND RETURNS.

The expenses connected with the experimental garden containing 5000 square feet during the last season are given in Tables XV and XVI. A summary of these expenses is as follows:

GARDEN.	
Labor	$16.61
Fertilizer	7.50
Seed	3.95
Equipment charge	3.00
Interest on land	1.50
HOT-BED.	
Equipment charge	$ 4.00
Labor	11.89
Total	$48.45

A considerable amount of the vegetables grown in the garden were sold, and the values given in Table XVII, are based upon these sales which were a little less than the retail prices set by the local grocers. They represent in most cases the minimum that one would have to pay for these vegetables if they were purchased for table use.

The total value of the vegetables taken from the garden and hot-bed was as follows:

Garden vegetables	$65.25
Hot-bed (lettuce and radishes)	6 33
Total	$71.58

After deducting $48.45 from $71.58 there is a net profit of $23.13 for the garden for one season. The yields and returns were much larger than for the first and second years, largely due to the increased fertility of the soil. On the same sized area, after the soil has been enriched and put in proper physical condition through a period of years, one should be able to double or treble these yields without difficulty.

It has been stated that the experimental garden yielded a profit of $23.13, but this represents in a very small way the value of a well-kept home vegetable garden. The con-

venience of having fresh vegetables at hand cannot be overestimated and cannot be valued in dollars and cents. Garden making is one of the privileges and one of the pleasures that should be enjoyed by a large majority of families and the time is at hand when more interest should be taken in the production of a home supply of fresh vegetables.

THE CITY AND SUBURBAN GARDEN.

For the city or suburban resident who does not have a plot 50 x 100 feet at his disposal, the farm garden plan herein presented can be divided into half making it 50 x 50 feet in size, only half of the space in the row being devoted to each vegetable or some vegetables being omitted. If it must be smaller still, the strip of clover may be omitted which will make the dimensions of the garden 35 x 50 feet. Well-rotted manure should be added as a substitute for the clover sod if the clover rotation is discarded. Otherwise the management of the city and suburban garden will be similar to that of the farm garden.

CHAPTER XII.

CLASSIFICATION OF VEGETABLES.

In planning and operating the home garden the matter of season, both in regard to length and temperature, is the most important consideration regarding each vegetable to be grown. The following classification, based largely upon the seasonal requirements of the various garden vegetables, should provide information that will aid in securing a variety and succession of crops throughout the season.

I. Long season crops:
  1. That are tender:
    (*a*) Started in the hot-bed:
      Tomato (Lycopersicum esculentum).
      Pepper (Capsicum annuum).
      Egg plant (Solanum Melongena).
      Sweet potato (Ipomea Batatas).
    (*b*) Usually started in the open ground, but may be started in the hot-bed.
      Beans.
        Limas (Phaseolus lunatus).
        Dry shell (Phaseolus vulgaris).
      Vine crops:
        Muskmelon (Cucumis Melo).
        Watermelon (Citrullus vulgaris).
        Citron (Citrullus vulgaris).
        Cucumber (Cucumis sativus).
        Gherkin (Cucumis Anguria).
        Squash (Cucurbita maxima, C. Pepo, C. moschata).
        Pumpkin (Cucurbita Pepo, C. maxima).

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2. That are hardy; started in the open ground:
   (*a*) Bulb crops:
      Onion, ripe (Allium Cepa).
      Leek (Allium Porrum).
      Garlic (Allium sativum).
      Shallots (Allium Ascalonicum).
   (*b*) Root crops:
      Carrot (Daucus Carota).
      Parsnip (Pastinaca sativa).
      Salsify (Tragopogon porrifolius).
      Horseradish (Cochlearia Armoracia).
   (*c*) Perennials:
      Asparagus (Asparagus officinalis).
      Rhubarb (Rheum Rhaponticum).
      Globe artichoke (Cynara Scolymus).
      Sea-kale (Crambe maritima).
      Chives (Allium Schoenoprasum).

II. Short season crops:
   1. Cool season crops sown in the open ground in early spring, and mature quickly:
      (*a*) Root crops:
         Radish (Raphanus sativus).
         Turnip (Brassica Rapa).
         Beet (Beta vulgaris).
         Rutabaga (Brassica campestri).
         Kohlrabi (Brassica oleracea, var. caulorapa.
      (*b*) Spring salad plants:
         Leaf lettuce (Lactuca sativa).
         Corn salad (Valerianella olitoria).
         Garden cress (Lepidium sativum).
      (*c*) Spring greens:
         Spinach (Spinacea oleracea).
         Mustard (Brassica nigra, B. Alba).
      (*d*) Tubers:
         Early potatoes (Solanum tuberosum).
      (*e*) Bulb crops:
         Onion, green (Allium Cepa).
      (*f*) Pea (Pisum sativum).

2. Cool season crops usually started in the hot-bed and set in the garden in early spring:
   - Head lettuce (Lactuca sativa, var. Capitata).
   - Cos lettuce (Lactuca sativa, var. Romana).
   - Early cabbage (Brassica oleracea, var. Capitata).
   - Early cauliflower (Brassica oleracea, var. botrytis).
   - Early celery (Apium graveolens).
3. Cool season crops started in the spring in the open ground and mature in summer:
   - (*a*) Summer greens:
     - Kale (Brassica oleracea, var. acephala).
     - Collards (Brassica oleracea, var. acephala).
     - New Zealand spinach (Tetragonia expansa).
     - Chard (Beta vulgaris).
     - Dandelion (Taraxacum officinale).
   - (*b*) Summer salad plants:
     - Endive (Cichorium Endivia).
     - Parsley (Carum Petroselinum).
     - Upland cress (Barbarea vulgaris).
   - (*c*) Beans:
     - String (Phaseolus vulgaris).
     - Green shell (Phaseolus lunatus).
   - (*d*) Corn:
     - Sweet corn (Zea saccharata).
     - Pop corn (Zea everta).
4. Cool season crops that are started in a seed-bed and make the most of their growth in the autumn.
   - Late cabbage (Brassica oleracea, var. Capitata and bullata).
   - Late cauliflower (Brassica oleracea, var. botrytis).
   - Brussels sprouts (Brassica oleracea, var. gemmifera).
   - Broccoli (Brassica oleracea, var. botrytis).
   - Celeriac (Apium graveolens, var. rapaceum).
   - Late celery (Apium graveolens).

CHAPTER XIII.

LONG SEASON CROPS THAT ARE TENDER.

This class of vegetables requires a long season in which to mature, and will not stand frost. They thrive best at summer temperatures, varying from 70° to 90° F., and are planted from the middle of May to the middle of June, after the weather has become warm and settled. With the exception of the beans and sweet potato, all of the vegetables in this class require considerable space in which to grow, and are planted or set in hills. It is sometimes possible to mature a quick-growing crop, such as radish or lettuce, on the land before these crops are planted.

(*a*) STARTED IN THE HOT-BED.

In order to mature a satisfactory crop yield, the tomato, pepper, egg plant, and sweet potato are always started in a hot-bed, or some other forcing structure having artificial heat. The normal frostless season in the Northern States is too short to produce a paying crop of these vegetables, and since they will not stand frost, they are started in the hot-bed four to eight weeks earlier than they can be set with safety in the ground. By this method the first three vegetables mentioned are brought into bearing three or four weeks earlier in the season, making it possible for them to bear a sufficient quantity of fruits to make them profitable. The sweet potato is started in the hot-bed to insure the maturity of the roots before frost kills the vines in the autumn.

TOMATO.

In its native home in the warmer parts of South America, the tomato is a perennial, living from eighteen months

to two years, and bearing fruits during a large part of this period. It is because of this inherited tendency of the plant to bear through a long season that it becomes necessary in northern latitudes to start the plants in the hot-bed in order to have good-sized plants to set outside as soon as the weather is suitable. The tomato is one of our most important vegetables, and should be grown in every home garden. It is also a profitable crop to grow in rotation on the general farm in regions where canneries are located.

FIG. 88.—The illustration at the left represents a desirable type of tomato fruit. It is large, has numerous small cells filled with pulp and surrounded by a tender fleshy growth.

Seed.—It has already been pointed out in a preceding chapter that there is a great difference in the value of tomato seed even of the same variety, as it is purchased from different seed firms. High yields of smooth, solid fruits can be secured only when carefully selected strains of desirable varieties are planted. High-grade tomato seed cannot be produced for less than $3 per pound, and some growers who buy their seed supply are paying $5 per pound for certain strains that they know from experience to be of superior quality. The beginning of a good crop of tomatoes, as with all other vegetables, is a good strain of seed. This is perhaps

more important with the tomato, since hundreds of pounds of poor quality seed are sold each year, that have been collected from the pulp at catsup factories.

Growing Plants.—In Chapter VI are discussed various methods of growing and handling hot-bed-grown plants, and the experimental results presented there show that the largest and most profitable yields are secured by starting tomato plants in dirt bands. This method should always be practised in the home garden, and is also desirable in field culture.

Setting.—With the plants grown in dirt bands, the setting may be done at any time without danger of losing any of them on account of the change. The plant, including the soil and band, is taken from the hot-bed and set a little deeper in the garden than it is in the band. If the plants are staked or supported, they may be planted as close as 30 inches apart in the row, but if allowed to trail on the ground, standard sorts should be set from 42 to 48 inches apart. Dwarf varieties are set as close as 30 inches apart.

Just previous to setting the soil should be worked until in fine tilth and the moisture extends to the surface. After setting the plant with the ball of earth attached to the roots, dirt is pulled up around it and packed firmly so that the soil moisture may pass to the roots. Cultivation should follow immediately to loosen the packed soil due to the tramping while setting.

Staking.—In the vegetable garden where intensive methods are practised staking is generally desirable. A strong stake about 5 feet in length is driven beside each young plant. When the plant is 15 inches high, it is tied to the stake with a soft, strong tying material, the latter being wrapped tightly about the stake two or three times to keep it from slipping, and rather loosely about the stem to prevent binding or cutting. As the plant grows, it is fastened to the stake at intervals of about one foot.

The object in staking is to keep the plants from falling down and spreading over the ground, and consequently requiring considerable space in which to grow. When trained to stakes, the plant is kept in the air and sunshine, so that the fruits ripen well and are prevented from rotting in damp weather.

Tomatoes for the Cannery.—In many agricultural regions are located canning or preserving establishments which contract a large tomato acreage with the farmers each season. The tomato is a desirable crop to grow on the general farm since it works well into the farm rotation, does not remove much plant food from the soil, for a large part of the fruit is water, and the crop returns a good profit when rightly grown.

The Soil.—The soil used for growing the tomato varies from a light sand to a stiff clay. Under favorable conditions a fair crop can be raised on a variety of soils, although the tomato crop, like any other, has its soil preferences.

The best all-round soil for the tomato under average conditions seems to be a rich, sandy loam. Because of its lightness and porousness, rains pass away readily, and the air and sunshine penetrate freely—conditions very essential to plant growth.

Fitting.—Fitting the soil is one of the most important considerations in successful tomato culture. If the ground is in sod or if the soil contains a considerable amount of clay, it is usually best to plow it rather deep in the late autumn and then disk it every two weeks in the spring until the young plants are ready to be set out. With loam or sandy soils not in sod early spring plowing is generally practised and the ground disked or harrowed occasionally to keep the soil loose and to keep the weeds down until setting time.

Just before transplanting the soil should be put into as fine tilth as possible. This can be done with from two to four thorough harrowings, the last one coming immediately before the plants are set in the field. The depth of plowing should be 8 inches or even more if the subsoil is not too near the surface. This will allow deep setting and give more territory for the plant roots to forage in.

No crop will respond more quickly or profitably to fertilizers added in the correct proportions and in the proper condition than the tomato. The ideal method of enriching the soil is by adding fertilizers and growing clover or other leguminous cover crops in years previous to the growing of the tomato. The plant food in a soil which has been made rich gradually through a number of years of good management is in better

condition for utilization by the tomato plant than if all are applied the year the crop is produced.

Barnyard manure and commercial fertilizers may be used. The manure is usually plowed under and worked through the soil later by harrowing or disking. The commercial fertilizers are put on after the soil has been prepared for the plants. The main portion of the fertilizers should go in the hill, with perhaps a third of it applied broadcast between the rows three or four weeks later. The fertilizer put in the hill should be placed about the plants without allowing it to touch them, as this often results in burning.

In a general way, for each acre use 10 tons of well-rotted stable manure worked into the soil in late fall and early spring, and from 300 to 600 pounds of commercial fertilizer containing 2 per cent. nitrogen, 10 per cent. phosphoric acid, and 6 per cent. potash worked into the row about the time the plants are set.

Growing Plants.—Plants are grown to best advantage in the hot-bed, which is prepared in early spring, so that the seed may be sown from the first to the middle of March, which will give plenty of time for the developing of good-sized plants. The seed should be sown thinly from one-fourth to one-half inch deep, and preferably in rows 4 to 6 inches apart, thus giving an opportunity for thinning and stirring the soil.

On warm days the bed should be ventilated to make the plants grow stocky and prevent them from wilting. Tomatoes thrive best at a temperature of from 75° to 85° during the day and about 60° at night. In watering, the aim should be to water thoroughly, but not often.

A week or ten days before the time to transplant into the field, or earlier if the weather permits, the sash should be removed during the day to harden off the plants. It is also a good plan to stop watering at this time and then wet down thoroughly just before taking the plants to the field.

Transplanting.—Transplanting the young plants in the field is done as soon as possible after all danger of frost is past, usually from May 15 to June 10. The best time for transplanting is on cloudy days when the soil is moist, or in the mornings and evenings if the days are warm and sunshiny.

Setting the plants in the field is done mostly by hand, although in some localities a two-horse transplanter is used. Three persons are usually required to operate the planter, and with it five to seven acres a day may be set. When the transplanter is used the soil must be in first-class physical condition and the plants of an equal height to ensure good results. If the plants are started in dirt bands the transplanter cannot be used.

The grower putting out from one to five acres, perhaps would not be warranted in buying a planter, and so necessarily sets his plants by hand. A hoe, spade, or some other tool is used for making the hole in the soil into which the roots are inserted and the soil packed firmly around them. As the tomato stalk takes root readily there is not much trouble in transplanting, provided it is not too hot and dry. When set by hand, cultivation should follow immediately to loosen the soil which has become packed.

The depth of setting varies with the size of the plants. If they are short and stocky, 4 to 6 inches is sufficient; but when the stems are long they may be set even a foot deep if the subsoil permits, without injury. It is a good plan to set them deep if the stalks are long and weak, in order to prevent the wind and rain from breaking them down.

The distance for planting tomatoes in the field is from 4 x 5 to 5 x 5 feet with the varieties that are now being grown for canning purposes. Plenty of space should be given for the plant to spread out and still have enough remaining room for picking at harvest time without stepping upon the vines.

Cultivation.—Cultivation is begun as soon as possible after the plants have been set in the field. This will loosen up the soil where it has been packed down during the work of transplanting, and will start the young plants into growth. The first cultivation may be rather deep and close to the plants, the shovels being set to throw the dirt slightly toward them. The succeeding cultivations, from seven to ten days apart, should be shallow and farther away, the aim being to form a dust mulch to prevent evaporation as well as to keep down weeds.

When the first fruits are beginning to set on the vines, cul-

tivation is usually discontinued. If the plants are still small they may be cultivated once between each row, care being taken not to shake the vines, which causes the small fruit to drop.

The tool commonly used in caring for the crop is the two-horse corn cultivator. One of these should be selected with several small teeth to break the soil in preference to those having two large shovels, which leave the soil in ridges. Level and shallow cultivation is preferable to hilling or ridging.

FIG. 89.—Setting tomato plants in the field. One man drops the plants for three men who do the setting. With two such crews in the field the setting is done as fast as the furrows are made which makes it possible to set the plants in moist soil.

Yields.—The yields to be expected with proper care and a good season, without exceptional losses from insect and disease attacks, may run from 6 to 12 tons per acre. Occasionally a grower reports a yield of 16 or even 20 tons. Roughly speaking, it requires a yield of at least 4 tons per acre to pay expenses at the usual contract prices.

Profits.—The profits depend upon the cost of growing, the yield, and the selling price. The cost of growing depends largely on the ability of the person growing the crop. Estimates of reliable growers place it at from $25 to $50 per acre. Probably $35 will be a fair estimate.

The price received for the crop varies from $7 to $10 per

ton, depending upon the canning company buying the fruit. Under the best conditions from $50 to $75 profit per acre may be realized; but if the crop does not receive the care and attention that it should, the profits are often very small, and in some cases the grower does not get any more out of his crop than the cost of producing it.

Pests.—The pests common to the tomato grown as a field crop are the potato beetle, leaf spot, and fusarium wilt.

The potato beetle is controlled by spraying, when the larvæ appear, with arsenate of lead, 3 pounds to 50 gallons of water. The leaf spot, generally known as "rust," is quite common with this crop. It is first noticed as small circular brown spots on the lower leaves. With favorable weather conditions the disease progresses rapidly upward, and soon weakens the plant to such an extent that the crop yield is considerably reduced. Bordeaux mixture, applied at intervals of two or three weeks, beginning at the time of setting in the field, will control this fungus.

The fusarium wilt, a bacterial disease, cannot be controlled by spraying. When attacked by this pest the plant wilts rapidly and the entire plant often dies. The only remedy is to practise rotation of crops in order to free the soil from the infection. Fresh soil should also be used in the hot-bed each season to prevent spread of the disease through this medium.

EGG PLANT.

The egg plant, sometimes called Guinea squash, is not commonly grown by the average gardener, although it is considered desirable by a majority of those that have become familiar with it. This vegetable flourishes in a warm climate, and is more sensitive to cold, and its growth more easily checked, than is the tomato.

The egg plant is a native of tropical climates and is cultivated almost everywhere in the tropical zone. In the United States it grows best in Southern localities, although it can be produced successfully in the North by starting the plants under glass.

The fruits of this vegetable are variable in color, shape and

size. The colors represented are black, purple, and white. The black-colored fruits are the most popular in the United States and the white sorts are preferred in Europe. The purple-fruited sorts are objected to because of their small size. The large-fruited varieties produce fruits 6 to 8 inches

FIG. 90.—The egg plant should be grown more commonly in the home garden. The fruits are prepared for serving by slicing and frying them. (The Country Gentleman.)

in diameter when mature. The fruits are prepared for serving by slicing and frying them.

Growing Plants.—The egg plant does not stand transplanting well, especially if all the soil is removed from the root system. For this reason it is best to start the plants in dirt

bands, in order that the roots will not be disturbed at any time during the growth of the plant. If grown in pots the plants should be shifted often enough to prevent the roots from becoming pot-bound. The seed should be sown in the hot-bed about 140 days before the fruit is wanted. The plants are usually set in the garden some time after the first of June, when the weather has become quite warm and settled.

Cultural Methods.—This crop requires a rich, moist soil and a warm temperature. The plants are set 30 to 36 inches apart in the row, with the rows 36 to 48 inches apart. Frequent cultivations to conserve the soil moisture is very desirable, for the plant will thrive in a dry, hot atmosphere if the roots have a sufficient supply of moisture.

The fruits should always be picked in the immature state, before they have taken on the deep dark color. If allowed to mature completely, the flesh becomes woody and the seed hard, which makes the fruit unfit for food.

Pests.—The flea beetle and potato beetle are serious pests of this crop, especially the former. Bordeaux mixture applied at frequent intervals acts as a repellent to the flea beetle, and Paris green or arsenate of lead will control the potato beetle.

PEPPERS.

Since the introduction of the sweet pepper its culture has been gaining rapidly in importance. It has become an important truck crop in some sections, and is being planted to a greater extent in the home garden. The pepper plant, although a native of subtropical countries, is grown quite successfully in the temperate zone. The plant is tender to frost but will thrive at lower temperatures than the egg plant.

The large-fruited pepper is mild in flavor, and is picked in the green state. It is used for making salads, mixed pickles, and stuffed peppers. The small-fruited sorts are mostly very pungent, are allowed to ripen on the vine, and are employed for flavoring and making hot sauces.

Culture.—The temperature and cultural requirements of this crop are quite similar to those of the tomato. They

require about two weeks longer time in the hot-bed than the tomato to grow to a desirable size for setting in the garden. The seed are planted under glass in February or March and require from ten to twenty days to germinate. The seed retains its vitality for about four years, although if left in the pods its longevity is extended to six or seven years. A light warm soil that is well supplied with humus and does not dry out quickly gives best results. After danger of frost is past, which is usually the latter part of May in the Northern States, the plants are transferred to the garden and set at a distance of two feet. The ground should be kept thoroughly cultivated if best results are to be secured with this plant. It is considered good practice to work the soil up around the plants to aid them in standing up against the wind and the weight of the fruits. When specimens of large fruits are wanted the tip ends are pinched off after the first fruits begin to mature. This limits the number of fruits on each vine and permits them to grow to a larger size. Harvesting is accomplished by cutting the stems with a knife or scissors rather than by pulling them off. In preparing peppers for the table the fingers should be protected by gloves in order to prevent them from being burned by the juice of the pepper fruits.

The maturity of the crop is hastened and the yield increased by planting on a southern exposure.

SWEET POTATO.

The sweet potato is a close relative of the members of the morning-glory family, and resembles the common morning-glory in many respects, with the exception that it produces a quantity of thickened roots which are used for food. The crop thrives best in a warm dry climate, and is capable of maintaining itself with little moisture after it has been well established. A sandy loam soil that is well drained, and that dries out quickly after heavy showers, produces short plump roots, whereas a wet soil or season may cause the roots to grow long and stringy.

There are three classes of sweet potatoes: the yellow, red, and white. The first mentioned is common in the North, and

the last is generally preferred for table use in the Southern States. The red sorts are less exacting as regards soil requirements, are generally more productive, and of poorer quality than either of the others mentioned.

Propagation.—The sweet potato is propagated from vegetative parts like the common potato although it is done in a different manner. The seed of the sweet potato are true roots while that of the Irish potato are underground stems. The roots of the sweet potato are seldom planted in the soil

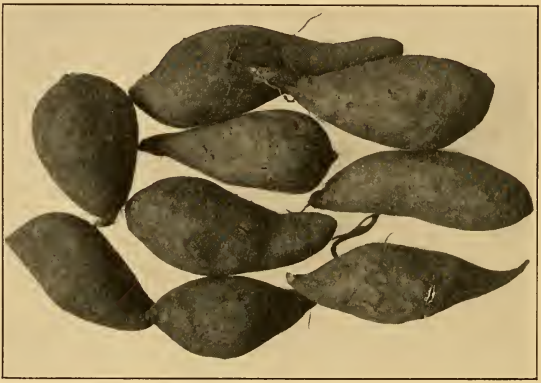

FIG. 91.—Uniformity in yama and sweet potato roots is sought for in the production of these crops. (The Country Gentleman.)

where the crop is matured. Seedling sweet potato plants are propagated by bedding the seed in a hot-bed. A layer of roots is placed on the hot-bed soil and then covered with two to four inches of light soil or leaf mould. The seed are bedded five to six weeks before the usual date of setting in the garden. The temperature of the hot-bed is held at from 80° to 85° F. for several days after the bedding has been done, and lowered gradually to about 60° at the end of the fifth week. Adventitious buds are finally formed on the roots and the development of new plants begins. A stalk is produced which grows

to the soil surface and forms leaves after which roots are formed where the stalk is attached to the seed. When a root system has been formed the young plants or slips as they are called are removed, care being taken that the sweet potato roots are not disturbed in the bed. In the Southern States the plants are reproduced by taking cuttings from the vines and planting them, but this is not practicable in cooler climates where the seasons are short. A few roots will be sufficient for producing enough slips for the home garden, as each will bear a large number of young plants.

Culture.—The sweet potato requires a large amount of plant food and thrives especially well in a rich soil. A sandy loam soil is preferable as it provides thorough drainage and warms up to a high degree. Heavy soils tend toward watery and poor quality roots. The land for this crop is carefully prepared by plowing and disking and then is ridged to a height of 8 to 12 inches. The slips are set on top of the ridge at intervals of 15 inches. Openings are made into the soft earth with a spade, the plant inserted and the soil firmed about it.

In the garden, cultivation along the ridges and between them is given with a hoe or rake until the vines almost cover the ground. At this time cultivation is discontinued and the crop left undisturbed until harvesting time.

The crop is harvested before the vines are killed by frost, if possible. The grower should be sure before digging that the roots are mature and a day should be selected when the ground is dry and the day bright. If frost should nip the plants, the roots should be dug in the next few days; and if this is impossible, the dead vines should be cut off at the ground with a hoe so that in rotting they will not carry the decay to the roots.

Care should be taken in digging or plowing out the potatoes to avoid all bruising by contact between the implements used and the roots. The soil should then be scratched away from the potatoes and they should be left exposed for several hours to dry. Picking should be in padded boxes, baskets, or crates. The roots should be carefully placed, not thrown into the picking receptacles. Although sweet potatoes do not

have the appearance of being easily bruised, they require in fact, as careful handling as oranges and apples.

Handling should be minimized to as great an extent as possible. This makes desirable a rough sorting in the field by placing the largest potatoes in one picking container, the smallest in another, and the bruised roots in a third. In no case should sacks be used either as temporary containers or for marketing purposes.

Storage.—Proper storage facilities are valuable to the commercial grower in that they do away with the necessity of selling the crop on digging, greatly lessen the heavy losses sustained when the primitive storage method of burying the potatoes is employed, and permit holding for good prices in winter or spring. A suitable structure with a capacity of 1000 to 2500 bushels can be built at a cost of from $100 to $500 depending upon the availability of lumber and other material. The storage house should have double walls to insulate against heat and cold and a false floor to facilitate ventilation. A stove should be installed to provide artificial heat. If bins are used they should have slatted sides, further to facilitate a circulation of air.

Sweet potatoes may be satisfactorily stored in bins, but where practicable it is advisable to store in crates or hampers, since such a practice reduces pressure on the roots, permits better ventilation, and confines such rotting as may start to a relatively restricted space.

Where storage is to be in bins or other receptacles these should, if they have been used before, be sprayed with solutions of formalin or copper sulphate. The former should be used in the proportion of one pint to thirty gallons of water. The copper sulphate should be used at the rate of one pound to twenty-five gallons of water. With either solution a second spraying should be given after twenty-four hours.

When first placed in the storage house sweet potatoes should be cured by being kept, by the use of a fire, in a temperature of 80° to 90° F. This curing temperature is maintained about two weeks and is then gradually reduced to about 55° and kept as near this point as possible. After this the ventilators are left open during the day in clear warm

weather, and kept closed during nights and in damp or rainy weather. When the temperature in the house goes below 50° the house should be opened if the outside temperature is higher, or a fire should be started to raise the temperature to the desired point, since once the potatoes have become thoroughly chilled their quality is impaired and they are more susceptible to decay. In order to maintain the proper temperatures accurate thermometers should be installed.

(*b*) USUALLY STARTED IN THE OPEN GROUND, BUT MAY BE STARTED IN THE HOT-BED.

Beans and vine crops, including muskmelon, watermelon, citron, cucumber, gherkin, squash and pumpkin are placed in this class. Generally the seed are sown in the open ground after the weather has become warm and settled. In order to secure earliness, some growers start these crops in the hot-bed by planting the seed in a dirt band, pot, or on pieces of sod, and later transplanting them to the garden. These vegetables can be successfully transplanted only when soil is taken with the plant and the roots left undisturbed. They cannot be handled as are sometimes cabbage and tomato plants with which almost all of the soil is removed and the roots left exposed until set.

BEANS.

Classification.—There are many classes of beans grown for food purposes. They vary in size, shape, color markings, habit of growth, and cultural requirements. The following arrangement will give an idea of the different classes.

I. String beans.[1]
- A. Yellow pod or wax
  - 1. Dwarf.
  - 2. Running
- B. Green pod.
  - 1. Dwarf.
  - 2. Running.

[1] Have been previously classed as short season crops, but are placed for convenience in this chapter with the other types of beans.

II. Green shell beans.
  A. Lima.
    (*a*) Large seeded.
      1. Dwarf.
      2. Running.
    (*b*) Medium-sized seed (Potato).
      1. Dwarf.
      2. Running.
    (*c*) Small seeded (Sieva).
      1. Dwarf.
      2. Running.
  B. Miscellaneous types.
    1. Dwarf.
    2. Running.
III. Dry shell beans.
  1. Dwarf.
  2. Running.

Dwarf and Running Varieties.—From the above outline it is noted that the dwarf or bush form and the running or pole form are common to all classes of beans. As a rule the bush forms are preferred, since they require no support and are more easily grown. The pole types are the oldest forms and generally yield the larger crop, and bear through a longer season.

String Beans.—This class of beans is grown for eating in the immature state. The fleshy, succulent pods, including the small, immature beans are used for food. The plant grows edible pods in from six to ten weeks, which must be picked soon after the proper stage of maturity has been reached, or the pods become dry and woody and are of little value. String beans do well on an average soil, and succession sowings are made to provide a supply through a long season. String beans may be had in either the yellow pod or the green pod varieties as preferred.

The seed is planted as soon as the weather is warm, shortly after corn-planting time, either in hills 30 inches apart each way with three to five seed in a hill, or in drills with the seed 4 inches apart. The rows are placed 30 inches distant.

Plantings are made every two or three weeks until the first of July.

The pole varieties are planted in hills 4 x 4 feet apart with four to six seed in each hill.

Green Shell Beans.—This type of bean is harvested, the beans removed from the pods, and used for food when the beans are about full sized but not mature. Almost any kind of bean can be grown as a green shell bean, but there are a few varieties that are especially adapted for this purpose.

FIG. 92.—String beans are grown for eating in the immature state The pods should be 6 to 7 inches long when mature. (The Country Gentleman.)

Green shell beans may also be used as dry shell beans when mature, if desired. The lima bean is one of the most important belonging to this class.

Lima Beans.—Lima beans, as a group, require higher temperatures and a richer soil than string beans. They are also more exacting in their cultural requirements and more difficult to grow. On account of their temperature requirements, they are planted two or three weeks later than the string bean. If earliness is desired, the seed are planted in dirt

bands in the hot-bed three or four weeks previous to the time that they can be safely set in the garden.

Of the limas, the small-seeded (Carolina or Sieva) requires a less fertile soil and is less affected by weather conditions, such as cool or hot temperatures, than the other two types. It is well adapted to the home garden, as it is easy to grow and will succeed under average conditions under which the others might fail, even if given good care. The large-seeded lima is preferred by some on account of the size of the bean, and it is grown with fair success by those who provide the best of soil conditions and give it the exacting care that it demands in the Northern States.

Dwarf limas are planted in the garden in hills 3 feet apart each way, or in drills with rows 30 inches apart and the plants 10 to 12 inches apart in the row.

The pole limas are planted in hills 4 feet apart and supported by poles 6 to 8 feet long, one driven at each hill. Sometimes the stakes in four adjacent hills are pulled together at the top and fastened. This arrangement makes a stronger support that is better able to withstand high winds, when the poles are covered with a heavy growth of vines.

Miscellaneous types of green shell beans include all other forms than the limas that are grown for this purpose. They produce rather large seed, and are grown in the same general way as are string beans.

Dry Shell Beans.—Under this class are grouped those beans that are matured entirely in the pod, the latter becoming dry and ripe before the crop is harvested. They are generally grown as a field crop, and being in the dry state, form a staple article of food that may be stored for a long period, as are the grain crops.

The red kidney and white pea bean are commonly grown on a field scale, more of the latter being produced and placed on the market each season than any other one variety. As a field crop, beans serve the same purpose as the clovers, in that they are legumes and add nitrogen to the soil. In regions where the bean thrives well, it is a desirable crop to include in the farm rotation, since it enriches the soil, grows to maturity quickly, and gives a good return.

Field beans are planted, cultivated, pulled, and threshed by machinery. The following recommendations for growing the white pea bean as a field crop have been taken from Michigan Experiment Station Bulletin 259. The directions given are based upon the practises in that State, which is the second largest bean-producing State in the Union:

The bean crop is not universally grown throughout this country. The States producing more than 50,000 bushels of beans each year, according to the Twelfth Census Report, are Michigan, New York, California, Florida, Wisconsin, Maine, Virginia, and West Virginia. Michigan, New York, and California produce over 60 per cent. of all the beans grown in the United States.

Varieties.—The field beans most widely grown, and probably the most popular commercially, belong to the pea group. The following names are commonly, though perhaps not properly, applied to the varieties grown, viz.: pea, navy, white navy, white field, marrow pea bean, etc. Despite the variations in name, the types are practically identical.

The five leading varieties of beans grown in Michigan are the pea, medium, red kidney, white kidney, and black turtle-soup. A great number of varieties of garden sorts are grown in the State by farmers to be used by seedsmen in the retail trade. The varieties in the pea group will in most cases outyield the other sorts and are the most profitable to grow.

Place in Rotation.—Beans should be grown in the regular rotation of farm crops and preferably on overturned clover sod. The following is a good three-year rotation, viz.: first year, beans, corn or potatoes; second, wheat or rye seeded to clover, and third, clover. If some alsike clover and timothy are mixed with the clover seeding, the hay crop may be followed by pasture, thus extending the rotation to four years if necessary. While this rotation is well suited to Michigan conditions, it can, of course, be varied to meet special requirements. The smaller varieties of beans mature most quickly, thus giving opportunity for the preparation for wheat or rye to follow.

Soil.—While clay loams or soils overlying limestone are most desirable, sandy and even gravelly loams may be used,

but these latter soils should contain more or less humus and the gravelly soil should not be too coarse. Beans may be grown on heavy clay soils, but the surface or underground drainage, or both, must be good, and special attention must also be given cultural methods to produce a fine, mellow seed-bed. Muck soils or those with a superabundance of humus are not suitable, as they tend to produce vines at the expense of the seed. It is also true that this crop will not thrive on low, wet, poorly drained soils. Beans seem to produce good crops on soil somewhat deficient in nitrogen when well supplied with potash and phosphorus. Contrary to a somewhat prevalent notion, beans will not produce well on very poor soils, but require a fair degree of fertility.

Preparation of the Soil.—It is essential that the plowing be done early in the spring, but, owing to the lateness of the dates of seeding, this is frequently neglected until the latter part of May, much to the detriment of the crop. After plowing the land should receive frequent cultivation to bring it to the best possible condition of tilth. These methods are productive of three principal benefits, viz.: First, plant foods are more readily available when the crop is sown; second, moisture is conserved for the needs later in the season; and third, the soil is in a large measure freed of weeds, before sowing, which would otherwise interfere with the crop.

In growing beans on light, sandy soils or others lacking in fertility it will be found profitable to top-dress with fine or well-rotted stable manure after plowing. If a manure spreader is used, from six to eight loads per acre will be sufficient. If applied by hand, more would be needed because of less even distribution. The stable manure may be supplemented by commercial fertilizers containing the following amounts of available plant foods per acre, viz.: from 15 to 20 pounds muriate of potash and from 20 to 30 pounds acid phosphate. These materials may be evenly distributed over the field by spreading them over the top of each load of manure applied by the spreader. These applications of fertilizer should be followed by the disk harrow in order to intermix the materials with the surface soil. This method tends to conserve moisture in addition to supplying plant food.

A prominent bean grower recommends the following: "Commercial fertilizers of the analysis usually recommended for wheat and other grain crops; that is, 2, 8 and 3 per cent. respectively of nitrogen, phosphoric acid and potash, may be used with profit to the amount of about 200 pounds per acre. In case the ground is moist and the weather warm so as to insure a quick germination, the fertilizer should be run in the hoe which carries the beans and in one hoe on each side as well, thus using nine out of eleven hoes of the drill. If conditions are not good for germination, run the fertilizer only in hoes on each side of the one carrying the seed. It does not do to have the bean lie long in contact with the fertilizer, as the germ is affected thereby."

Planting.—From one-half to three-fourths of a bushel of seed per acre of the smaller varieties of beans is sufficient. All of the large varieties, such as red kidney, require one bushel to the acre.

The time of planting varies with the season and the varieties grown, extending from June 1 to 25. The larger varieties such as kidney and turtle-soup may be planted earlier than the pea sorts. Too early planting of beans is to be avoided. If conditions such as cold and excessive moisture prevail, the seeds are easily spoiled before germination. It is better to delay planting, awaiting favorable conditions for quick germination and rapid growth.

One of the best machines for planting beans is the ordinary eleven-drill grain seeder with seven-inch spaces between the tubes. Stop up all the tubes except the second, sixth, and tenth and let the drill wheel follow in its own outer wheel mark instead of in the last drill mark as in sowing grain. This will plant three rows at a time twenty-eight inches apart, which is about the proper distance. In planting the larger varieties of kidney beans, a bean attachment or special bean drill should be used. Some makes of grain drills have attachments for planting beans. Planting in rows will produce better yields of beans than planting in hills or check rows.

Care should be exercised in the selection of beans for seed. None but the best hand-picked beans should be used for plant-

ing, as the success of the crop is quite largely dependent on the vitality of the seed.

Cultivation.—Much of the cultivation work on the bean field should be done before the seed is planted by producing a good, clean seed-bed. If this has not been done, and the beans come up quickly, cultivation should begin promptly. As the rootlets of the bean plant grow near the surface, they should not be cultivated too deeply, not more than one and a half inches for the best results. We believe growers suffer severe losses by too deep cultivation, especially during drouth. Most growers do not cultivate while the leaves are wet with dew or rain for fear of causing the spread of anthracnose and bacteriosis.

Harvesting and Marketing.—The time for harvesting beans depends largely upon climatic conditions, earliness of planting, and varieties grown. The latter part of August and early September comprise the common harvest time. If weather conditions are favorable for quick curing, it will be well to begin harvesting before the beans are ripe enough to shell. On the other hand, if weather conditions are unfavorable, it is well to let the crop get ripe so that most of the leaves have dropped off. The crop will then cure quickly and can be stored away. The sooner the bean crop can be stacked or housed safely, the less the liability to loss by unfavorable weather.

The pulling of beans is usually done with a bean puller or harvester, replacing the old tedious, back-breaking method of pulling by hand. The bean puller pulls two rows at a time, placing them together in a row between. Care should be taken to have the draft to the puller adjusted so that the blades cut about one and a half to two inches below the surface the whole length of the puller blade. This should be adjusted with each team that is used by raising or lowering the end of the pole, so that when the blades strike the ground they will cut the whole length. Men should follow with forks and put the beans in small piles, about four to six rows into one, for convenience in hauling. The rows of piles should be far enough apart so the wagons can be driven between them. In some parts of the State the side delivery

rake is used for separating the beans from the ground after being pulled. This is objectionable on all but light soils, as it gets too much soil among the vines and as the threshers do not separate the soil from the beans, they go to the elevators in that condition.

Should the beans get wet after being pulled, they ought to be turned as soon as possible after the storm. The wetting of beans does not injure them materially, provided they are not allowed to lie on the ground without being turned over. They should be stacked or put in sheds or barns as soon as cured.

Beans are now threshed by a special machine or beaner which has been instrumental in materially increasing the acreage of beans grown. These machines are usually introduced into localities where beans are grown commercially, and offered for hire on a plan similar to that used by grain threshers.

The usual practice is to market beans in the condition in which they come from the beaner, leaving the cleaning, grading, and picking to the elevator men. Michigan has over 200 bean elevators well equipped with the latest and best machinery for this work. Most bean elevators will furnish the grower with enough two-bushel sacks to hold his crop, providing the grower will sell the crop to them. The elevator men then prepare and distribute the crop to the different markets for consumption.

Bean Diseases.—There are two diseases that are commonly found attacking this crop wherever it is grown. These are the bean anthracnose and the bean blight.

Bean Anthracnose.—The bean anthracnose is a fungus that is often introduced into new fields by means of affected seed. As the seedling comes above the ground, the disease spreads to the parts of the growing plant. Cultivating or walking through a bean field when wet aids in the spread of the disease. The most damage is done by the fungus when it attacks the pods and penetrates to the seed within, producing a spot upon it.

Bean anthracnose thrives and spreads rapidly in continued wet weather and during extended periods of heavy dew.

Moist conditions are required for the formation and germination of spores and the spread of the disease to the stalks, leaves, and pods of nearby plants.

The methods of control are spraying with Bordeaux mixture and selecting clean seed. The former method is still in the experimental stage and its value has not been fully determined. It has been found that the disease can be absolutely avoided by securing seed from clean pods. Only pods that have no disease upon them whatever, should be selected, and as soon as they are taken they should be kept away from diseased pods. As a further precaution, the clean pods may be dipped for ten minutes in corrosive sublimate (one part to one thousand parts of water). Dry in the sun and shell, taking care that the dust from the bean field will not have access to them. The seed is immediately sealed in air-tight jars and is planted the following season in a seed plot on clean ground. If any diseased plants are detected they are pulled out and burned. Such pod selection has given excellent results, and has been known to eliminate the disease almost entirely.

Bean Blight.—Bean blight is caused by a bacterial growth, the germs of which are carried over from one season to the next on and in affected seeds, and perhaps on diseased pods and litter. It is controlled to quite an extent in the same way as anthracnose, but not completely, as the minute bacteria may still be present after these precautions have been taken.

Good clean seed that is hand picked and entirely free from discolorations should always be planted when possible, in order to aid in the control of these two diseases.

MUSKMELONS.

Types.—Muskmelons may be arbitrarily classified in several ways, none of them being ideal in every respect. Two characteristics that may be used in grouping them into types is that of size and color of flesh. The large sized muskmelons are grown by vegetable gardeners near large cities and by the home gardener. The small-sized, commonly known as canta-

loupe, is common on the market, and is grown extensively in large melon-growing regions, as it is small, of uniform size, nearly spherical, and easily packed in standard crates for shipping.

Cultivated muskmelons have a yellow or green flesh. The latter are considered to be of the highest quality, whereas the former has the more attractive appearance. Thick-fleshed varieties of either class, with small seed cavities, contain a larger percentage of edible melon, and are generally of higher quality than the thin-fleshed sorts. A good solid netting on the rind also indicates high quality.

FIG. 93.—A desirable type of melon to grow. The netted skin indicates high quality.

Growing Plants.—The seed are sown in the open ground when weather conditions are satisfactory, or are sown in dirt bands in the hot-bed. For the home garden, the latter method should be followed in order to secure an early and maximum crop, and to avoid serious attacks of the cucumber beetle, which occur in the garden just after the plants have come up and are still succulent and tender. Four or five weeks before setting time four seed are sown in each band, and when the plants are an inch high, the two best plants are left and the others cut off or pulled. The temperature in the

hot-bed is kept at 80° F. during the day, and around 70° F. at night.

Culture.—Although the muskmelon can be grown on a variety of soils, a sandy loam is best adapted for growing this crop. The light soil also produces a melon of higher quality.

After the land has been carefully fitted, it is furrowed out both ways to a depth of six inches with a lister. The rows are made from 4 x 4 to 6 x 6 feet apart, which makes the hill the same distances in the row respectively. On an average soil, one-half peck of rotted manure is placed in the bottom of the furrows at the cross marks, and then covered with a layer of soil to keep it from coming in direct contact with the melon plant. If the young plants have been started in the hot-bed in pots or dirt bands, they are brought to the place of setting and set so that the hill is level with the surrounding soil surface. If seed is to be planted instead, a space about seven inches across is made level with soil, at each hill on top of the manure, and eight to twelve seeds planted and covered with moist soil. In central latitudes the seed may be planted by May 15. When the planting is completed, the hill should be on a level with the adjacent soil. After the plants have come up and the striped beetle is no longer attacking them, they are thinned to the two or three best ones in each hill. Sometimes the seed are sown in drills with one seed about every two feet in the row.

Cultivation is commenced soon after planting, and is continued until the vines interfere. Some growers turn the vines in order to cultivate once or twice after the growth has nearly covered the ground. After the horse cultivation has ceased, hand hoeing is resorted to as a means of preventing the formation of a crust about the hills after rains, and to prevent the growth of weeds and grass.

Cantaloupes as a Field Crop.—The following information is taken from Purdue Agricultural Experiment Station Bulletin 123, and gives the methods pursued in growing the cantaloupe in one of the important commercial cantaloupe regions of Indiana:

Starting the Plants.—In the vicinity of Decker the cantaloupes are always started in hot-beds. By this means the

ripening season is advanced from one to two weeks. These beds are substantially built of 2 x 8 planking and are 9 feet wide and from 25 to 40 feet long. Many of them hold 2000 to 3000 young plants, or enough to set out nearly two acres. A single grower frequently has a range of 30 to 40 of these hot-beds, enabling him to set from 50 to 75 acres of cantaloupes. The beds are usually placed in a warm and sheltered situation, so as to get the full benefit of the early spring sun. The seed is started during the last week of March or the first of April in small veneer boxes. These are about 5 inches

FIG. 94.—A convenient method of watering cantaloupes in the cold frame. Large quantities of water are required during warm bright days.

square and are similar to berry boxes, except that the bottoms are flush instead of recessed. These are placed side by side in the bottom of a hot-bed and filled with finely prepared earth and compost. Great care is taken with the material for the seed bed, and it is very thoroughly worked over before being used. The soil is made firm and allowed to come slightly above the tops of the boxes in the hot-bed. It is then marked out in squares in such a way that the intersection of the marks center the boxes. The seed-bed is now ready. After putting in the seed, careful attention is given to watering, to ventilation and to keeping out weeds. A day temperature is maintained at first of about 50° to 60° F. As the time for transplanting draws near more air is given in order

to harden off the young plants. The seedlings are moved about in the beds to fill possible vacancies and by the time they are ready to transplant a perfect stand has been secured with one plant in a hill.

Several plans for watering are in successful use. A common method is to mount a tank on trucks and drive along the hot-beds, watering through a lead of hose, provided with a rosette. Some growers, whose beds are near their windmills, have pipe lines laid among their beds with hydrants conveniently located for watering with the hose, the pressure being supplied by a tank in the windmill tower.

Transplanting.—About four weeks after seeding, or from the first to the tenth of May, the true leaves are forming and it is time to transplant from the hot-bed to the field. To move the young plants quickly and economically, a large force of men is required. The field has been prepared by furrowing one way with a lister and marking the other way so that the intersections are 5 x 7 feet apart. This is the common distance, although some growers prefer to set $4\frac{1}{2}$ x $6\frac{1}{2}$. The former gives about 1250 plants per acre, the latter about 1500. The plants in the hot-bed are thoroughly watered, and then loaded on long, flat-bedded wagons. The load is driven carefully to the field and the young plants which are still in veneer boxes are set off along the row at the intersections. A gang of boys armed with stout pocket knives now comes and slits the corners of the veneer so that the soft wood easily falls away. The undisturbed plant with the cube of earth and compost holding it is placed in the row. Another gang soon arrives and brings the sand up carefully and firmly about the block of hot-bed earth holding the plant. Some growers do this work with hoes and some go on their knees and use their hands. Care is taken not to push the plants down into the sand and thus disturb the roots. The sand is simply brought up around the plants. Handled by this method they receive very little shock and growth is not interrupted. Level culture and not hilling up is the rule. In this way the moisture is better conserved and horse cultivation can be practised both ways of the row.

For the first two weeks after transplanting cultivation is

almost constant. A crust should not be allowed to form. Some growers use the double-shovel plow, but this usually goes too deep. Cultivation should be shallow, thorough and constant. When the runners get too large for horse cultivation in both directions, the vines are laid in windrows, having the runners all approximately in line, thus giving opportunity for horse cultivation to proceed for some time in the other direction of the row. The spaces not covered are hoed by hand. When the runners nearly cover the ground cultivation ceases and the crop is "laid by" until harvest.

FIG. 95.—The undisturbed plants with the cubes of earth are hauled carefully from the cold frame to the field and set off along the row. The setting gang then places them in position and brings the soil up around them.

Harvesting and Marketing.—Cantaloupe picking usually begins about the first week in July, but the heavy shipping of course is not done until later. Considerable experience is required in order to determine the exact time a cantaloupe should be picked for shipment. It must be fully grown and netted, but it is unsafe to wait for much of the yellow color of ripeness to appear. 'Lopes picked while still green in color

and shipped in a refrigerator car, develop the fine, ripe color within a short time after being taken from the car and have a quality which equals or surpasses those which have been sun-ripened. If they are picked a day or two before they should be, the flavor never develops. Only experience can enable one to recognize the happy medium and to know exactly when to pick. The pickers are sent out with baskets and carefully go over the field, picking only those which are ripe enough for shipping. The melons are transferred to crates at the end of the row, which are collected and hauled to the

FIG. 96.—Crate holding twelve melons. The sides of the crate are sprung slightly by using larger melons in the center so as to prevent bruising when shipped.

packing shed. This structure is usually open with room for making and storing baskets and for sheltering several loads of the packed product. On one side is a large inclined table, capable of holding several wagon loads of 'lopes. The load from the field is driven alongside the shed and emptied onto the table. In front of the packing table there is room for from one to four packers. The baskets used are of the half-bushel climax type and hold sixteen melons packed in two layers. Long experience is required to make a quick and solid pack. The bottom of the basket is smaller than the

top and must have the smaller melons—the top layer must come about an inch and a half above the basket edge to allow proper covering. In addition every melon must be firmly in position and the basket present a neat and attractive appearance. An expert packer will stand before a loaded table and pack the melons as fast as he can pick them up, which he does apparently at random. Split, over-ripe and cull melons are thrown out while packing progresses. During the season of 1908, on account of the excessive rainfall, melons ran larger than usual, so that the basket would not always accommodate them. An innovation was introduced in consequence in the way of crates. Two sizes were used, the best being the pony crate, holding twelve melons of the larger size. This package was quite successful and there seems to be a good place for it on the market.

After packing the baskets are stacked high on large platform wagons and hauled direct to the refrigerator car. These cars are of varying capacity but those most commonly used contain about 1200 baskets when loaded six deep. The cars are usually iced before and re-iced after loading. A third icing on the road may be necessary for distant markets.

Several methods of selling are employed, with varying degrees of satisfaction. During the shipping season many large wholesale houses send their agents out to represent them. A large part of the product is disposed of by selling on track to these buyers. Several growers usually combine in loading so as to ship only in carload lots. More or less competition is created among the buyers which tends to prevent prices from falling too low. Moreover, by this method of selling, all anxiety is removed from the grower's mind about the possibility of unfair treatment from his commission man, or about meeting a glutted market, or about fluctuation in price while the car is en route. He sees and knows the man with whom he deals, both see the melons and agree on the price. All risk from the time of shipping is taken by the buyer. Some growers consign their product to commission houses and some sell to local buyers.

Unfortunately there are in some melon-growing communities, nearly always one or two growers who are so attracted

by the high price prevailing early in the season that they cannot wait until the crop is mature, but insist upon marketing melons which are so unripe that they fail to develop the flavor and quality they should have. Such melons are disappointing to the consumer and reflect upon the business reputation of the community, especially when that community is attempting to build up a reputation for a high quality product.

Pests.—The most troublesome pests common to the muskmelon are: the striped cucumber beetle, melon aphides, and melon rust.

Fig. 97.—A traction power machine for spraying cantaloupes. The boom at the rear is adjusted to spray three rows at a time.

Striped Beetle.—The striped beetle attacks the plants just after they appear above ground, and if not controlled may soon ruin the crop. In the garden the plants can be protected by covering them with netting or a screen dome. In field culture the plants are sprayed with Bordeaux mixture and Paris green, the former being used at half-strength and the latter at the rate of 4 ounces to 50 gallons of Bordeaux. The Bordeaux acts as a repellent, and the poison kills those that remain on the plants for any length of time. Dusting the plants with sifted wood ashes or land plaster, to which has been added a small quantity of carbolic acid or turpentine, will control the beetle, provided it is kept on the vines while

they are doing damage. About 3 tablespoonfuls of the liquid are thoroughly mixed with 4 quarts of the powder.

Melon Aphides.—The melon aphides, or lice, first attack the plants in early summer and are most prevalent in hot, dry weather. They first appear in small colonies and only on a few hills widely scattered over the field. The insect works on the under side of the leaves where it sucks the juices of the plant and consequently is difficult to control. It is often possible to rid the field of the insect by completely destroying the vines, including the lice at the hills where it makes its first appearance. Nicotine sulphate, or "Black Leaf 40," as it is commonly called, used at a strength of 1 part to 1000 of water will control the lice if sprayed onto the vines in such a way that it strikes all of the insects. Being a contact insecticide, it will kill only those that it strikes. An angle nozzle on a short spray rod, a high pressure, and applying when the insect first appears, are necessary for successful results.

Melon Rust.—Melon rust attacks the crop late in the season, usually about the time the first melons begin to ripen. It is a fungous disease, which attacks the foliage, partly or wholly destroying it, so that the melons ripen prematurely, or fail to ripen at all. Its first appearance is characterized by small circular brown spots on the leaves, which multiply and eventually run together, causing the leaf to turn brown and shrivel. Warm weather, with frequent showers, is especially favorable to its development.

The rust can be controlled to a certain extent by thorough and repeated sprayings with Bordeaux mixture at one-half strength. Applications are made once per week from the time the fruits begin to set until harvest time. The Bordeaux retards the development of the fungus and does not completely eradicate it.

Rust-resistant strains of muskmelons have been developed recently, which are able to withstand the attacks of the rust quite well, and where these are grown, spraying is not so necessary.

WATERMELON.

The watermelon is an important truck crop in the United States, and is grown extensively in the Southern States to supply the Northern markets early in the season. It is likewise grown extensively in the home gardens in the Northern States to provide a supply for home use during the late summer and autumn.

FIG. 98.—Watermelons from the home garden are of better quality than those taken from the neighboring patch in the moonlight.

Growing Plants.—In order to grow an early crop in the home garden, the plants are started in dirt bands in the hot-bed, as previously given for the muskmelon. The seed are more commonly planted directly in the garden, but the length of the season is rather short in which to grow a sufficient number of fair-sized melons. The plants are very sensitive to changes at transplanting time, and should be handled very carefully as they are being taken from the hot-bed and set. The soil about the roots must not be disturbed in the least.

Culture.—The culture of this crop is quite similar to that already given for the cantaloupe. It grows well on sandy hot soils that are well drained and will thrive during hot, dry weather with but little cultivation. The distance for plant-

ing varies from 8 x 8 to 10 x 10 feet, the latter being the more common. If the crop is started in the garden, ten to twelve seed are planted in each hill, and later thinned to the one or two best vines. It is not desirable to plant the watermelon continuously on the same land, as this practice will exhaust the soil and make possible the development and spread of the melon wilt, which will live in the soil for four or five years after it is once introduced.

CITRON.

The citron is similar to the watermelon, both in regard to plant growth and culture. The main distinctions between them are that the fruit of the citron has a flesh that is like the rind of the watermelon, and that the citron is adapted to a wider range of soil conditions. The citron is not edible in the raw state, but is used largely for making preserves and sweet pickles. It is also used in jelly making, on account of the large amount of pectin contained in the pulp and juice, which causes the juices of fruits to "jell" readily.

CUCUMBER.

The cucumber is grown in the open for slicing purposes and for pickles. It is also grown in forcing structures for slicing purposes during the winter months when it cannot be had in the fresh state from the field or garden. In the home garden the cucumber is grown early in the summer for slicing, but the main portion of the crop is produced for pickles.

Growing Plants.—For home garden use, where the cucumbers are desired as early as possible, the plants should be started in the hot-bed in dirt bands about four weeks before they can be set in the open ground. They are started and handled in the hot-bed, as already given for the muskmelon.

Culture.—The cucumber thrives in a deep rich retentive loam. When the soil is of average fertility well-rotted manure should be placed under each hill as recommended for the muskmelon.

Planting is done after there is no danger of frost, which is about May 15 in the Northern States. The plants from the hot-bed are set in hills 5 x 5 feet, with three or four plants in a hill. They are also grown in rows 6 feet apart with the plants 1 foot apart in the row. If seed are planted, ten to twelve are placed in each hill at about the date mentioned above. After the plants are up and growing well, they are thinned to three or four plants in each hill.

FIG. 99.—Cucumbers are grown in the greenhouse for slicing purposes during the winter months. The vines are supported by an open framework in the upper part of the house.

Harvesting.—Cucumbers for slicing should be at least six inches long when picked. For pickles they are picked three inches and under in length. In order to gather all of the cucumbers when of the desired size, the vines must be picked over regularly two or three times each week, and since the small sizes are hard to see, especial care should be taken to find them. None of the fruits should be allowed to turn yellow or ripen on the vines, for as soon as the plant produces seed or begins to throw its energies into seed production, the amount of blooms produced is reduced, and consequently the crop yield. In order to prevent injury to the cucumber plant

and all other vine crops, the vines should not be tramped and should be handled carefully when the fruits are being picked.

Cucumbers for Pickles.—The cultivation of this vegetable for pickling purposes has become of considerable importance in certain sections of the United States. In most localities the business has been of short duration. The length of time for any one locality has been from six to ten years due largely to a lack of control measures for combating insect and fungous pests after they have made their appearance in territories where the cucumber is grown as a field crop for pickle factories. At the present time experiments are being conducted along the line of pest control and perhaps in the near future successful methods of combating these troubles will be developed.

FIG. 100.—Putting down pickles in brine at a salting station. The growing of cucumbers for pickles is practised on an extensive scale in regions adapted to the culture of this crop.

Salting stations are located at the main gathering points and are in the main of inexpensive construction since they are used for only a few years.

The price paid for cucumbers is remunerative to the grower and if the business could be conducted on a large scale it would be a profitable one. This has been impossible on account of the large amount of hand labor that is required for harvesting

the crop. The average farm family is capable of harvesting not to exceed two acres. Even with this acreage the picking cannot always be done properly in mid-season. In spite of the difficulties encountered in harvesting, many growers make a net profit of $100 to $200 per acre per season from a small patch of pickles.

The soil best adapted to the production of cucumbers for pickles is a sandy, gravelly, or clay loam. The gravelly and clay loams are most desirable for the crop when it is grown late in the season as a main crop. After the soil has been prepared as for any hoe crop it is marked off in checks 6 x 6 or 3 x 6 feet. Some prefer to plant in drills 6 feet apart but the crop can be cultivated more thoroughly and cheaply with the check system. If well-rotted manure can be secured it is well to put a forkful under each hill. This is accomplished by removing the soil to a good depth where each hill is located, putting the manure in and then covering it with 3 or 4 inches of soil upon which the seed are planted. When the check row system is followed, ten to twelve seed are scattered over an area about one foot in diameter. Later the plants are thinned to four to six to the hill. Clean cultivation then follows and is continued until the vines cover the ground.

The time for planting varies with different regions and extends from June 1 to July 1. In some localities it is a common practice to make two plantings, one about three or four weeks after the other, to have fresh vines coming into bearing during the latter part of the season when those planted early have been almost or entirely killed by fungous or bacterial diseases. Harvesting begins the last of July and continues without interruption until frost or pests kill the vines. As already mentioned the cost of picking is unusually high because of a dislike of the average farm laborer for this kind of work. It is not uncommon for the grower to give the pickers one-half of the crop for doing the harvesting, and even with this arrangement the crop is generally a profitable one to grow. Pickles under three inches in length average $1 per bushel at the salting station. Those above three inches are used for making dills and bring from twenty-five to forty cents per bushel.

Pests.—The insects and diseases attacking this vegetable are similar to those given for the muskmelon. The striped cucumber beetle is a serious menace and is difficult to control. Most damage is done when the plants are young and tender, although the beetle also feeds on the old plants and the fruit. The hibernating beetles devour the tender young plants and the larvæ attack the roots. This insect is common to the other cucurbits. Various methods of controlling it have been given under Muskmelon. In addition to those mentioned, two parts of hydrated lime mixed thoroughly with one part of tobacco dust and dusted on the vines will keep the beetles at a distance.

GHERKIN.

This vegetable resembles the cucumber in its habit of growth, and produces fruits that are small, of an oval shape, and that have a prickly growth on the skin. They are used for making pickles, and as such are of very high quality. The disadvantage in growing the gherkin is that it is so small that considerable labor is required in picking them. Four or five hills will be as many as the average family will care to pick. Their culture is similar to that of the cucumber, and as a crop they are much less exacting in their cultural and soil requirements.

SQUASH.

This vegetable, although a fairly important one, is not well enough known and appreciated by the home grower of vegetables. There are different kinds and classes that are suitable for summer and winter consumption, and that have different habits of growth, all of which should be fully understood before an intelligent selection can be made.

The summer varieties are used before they ripen and the seed and shell become hard. A majority of the summer squashes are of the bush form, which are easier to cultivate than the running forms. This type is desirable for summer and early autumn use, and must be used in the immature state.

The winter squash generally has a running vine, is allowed to mature before picking, and is stored for winter use. As a class, winter squashes are more exacting with respect to soil and climate than summer squash. The stems and leaves are larger, more fleshy and succulent, require more moisture and are less capable of withstanding hot, dry weather or competition from other plants, such as corn, among which squash are often grown. The winter varieties produce fruits of much greater size than the summer varieties.

Fig. 101.—Different types of summer and winter squash. (The Country Gentleman.)

A variety of forms, sizes, and colors of fruits are common in these two classes, which gives an opportunity for a wide selection to meet the desires of the grower.

Culture.—The culture of the squash is not unlike that of the other cucurbits. The plants are not so tender as the melon and cucumber, and yet will not stand frost. The summer varieties should be started under glass in order to secure earliness. The winter sorts are generally started by planting the seed in the open ground. Bush varieties are planted as close as 4 x 4 feet, and those that run, from 8 x 8 to 10 x 12 feet. Two or three plants are left to mature in each hill when the thinning is done.

The squash is easy to grow and does well in a warm, quick

soil. It is a long season plant and in some seasons is caught by frost. In order to plant early and avoid autumn frosts, the crop is grown on loose, light soils, a sandy loam being preferred. Too rich soils are to be avoided, as the strength of the plant will all go to vine and little or no fruit be produced.

A good squash vine may be expected to bear two or three good-sized fruits. If one flower sets early in the season, the strength of the vine may all go into the development of the one fruit and no others be borne. Where one fruit sets far in advance of any others that may come, it should be removed if more than one mature fruit is wanted. Small varieties sometimes bear five or six squash under favorable conditions.

Storage.—Squash may be stored successfully until the holidays if handled properly. W. W. Rawson gives the following directions for storing them:

"Cut the squashes just before they are thoroughly ripe. Be careful not to start the stem. Lay them on the ground one deep and let them dry in the sun two or three days before bringing them to the building. Handle very carefully when putting in, and be sure that the wagon in which they are carried has springs. Put them two deep on shelves in a building. This should be done on a cool, dry day. If the weather continues cool and dry, keep them well aired by day; but if damp weather comes build a small fire in a stove in order to dry out the green stems. Keep the temperature about 50° and air well in dry weather. The squashes may need picking over about Christmas if put in the building about October 1; handle very carefully when picking over. Fifty tons can be kept in a single building with a small fire. Do not let them freeze, but if the temperature goes down to 40° at times it will do no harm, nor should it be allowed to go as high as 70°. The Hubbard squash keeps best and longest and does not shrink in weight as much as other kinds, but any of them will shrink 20 per cent. if kept until January."

Pests.—Other than the pests mentioned under the cucurbits already discussed, the squash or "stink" bug should be considered with this crop. The adult bug attacks the plant and injures it by sucking the juices and by injecting a poisonous liquid that causes the death of the cell tissue adjacent to

the puncture. It also transmits the wilt of the cucumber and melon upon which it may feed if the squash is not present.

The remedies given for the control of the striped cucumber beetle will assist in the control of the squash bug. In the home garden it is often feasible to catch and kill the first bugs that appear and to destroy the eggs that are laid on the leaves. Trap crops are of some value.

FIG. 102.—A crop of large sweet field pumpkins planted after a crop of early potatoes had been harvested. (The Country Gentleman.)

PUMPKIN.

The pumpkin is very closely related botanically to the squash, especially the summer type, and in some countries they are all classed as pumpkins. This crop is grown for making pies and for stock feed. When produced for the latter purpose it is grown as a companion crop in corn. The pie pumpkin is grown in the garden and is handled in a manner similar to that already given for the squash. The fruits are stored for winter use, or the edible portion is canned or dried, for making pies when the pumpkin cannot be had in the fresh state.

CHAPTER XIV.

LONG SEASON CROPS THAT ARE HARDY.

STARTED IN THE OPEN GROUND.

Bulb Crops.—The bulb crops, of which the onion is the most important, are hardy, will stand frost, and some forms are not injured by freezing, but live through the winter in the soil and send out new growth in the spring. They can be stored through the fall and winter in the mature state and consequently are a rather staple product. As a food they are used in the green or mature state, either raw or cooked, and alone or combined with other foods, principally as a flavoring medium.

ONION.

Onions thrive best in cool weather and with an abundance of moisture during their early development. Later in the season, after the root system is well established, they are able to grow to maturity in dry, warm weather. Only onions that are properly matured will keep well in storage, and in regions where autumn rains come early it is necessary to have the onion crop ripened, cured, and ready to store previous to this time. If ripe in August or early September, the crop will usually escape the wet season, and in order to have the crop ripen early it must be properly started and well cared for during its growing period.

Classes.—Onions may be classified for convenience as follows:

I. Green onions:
   - A. Grown from sets (yellow, red, white).
   - B. Grown from seed (yellow, red, white).
   - C. Grown from potato, multiplier, and perennial onion.

II. Ripe onions.
  A. American:
    1. Grown from seeds or sets.
      (*a*) Yellow
      (*b*) Red
      (*c*) White
  B. European.
  C. Bermuda.

The American type of onion is the one most commonly grown in this country, and compared with the European or foreign types, the bulbs are smaller, of firmer texture, possess a stronger flavor and better keeping quality, and mature earlier in the Northern States. The white varieties are preferred in the East, red in some parts of the North, and the yellow in the Middle West. Other than the color distinctions, onions grow in different shapes, varying from globular to oblate or flat. Generally speaking, the globular-shaped varieties produce the largest yields and are in greatest demand on the market.

Fig. 103.—Three distinct types of onions. Southport Yellow Globe at the left, Prizetaker (white) in the centre and Red Wethersfield at the right. (The Country Gentleman.)

Of the various types of European onions, the type represented by the Prizetaker variety is best adapted to the climate and soil of America. This sort matures almost as quickly, is of milder flavor, and larger size, and keeps about as well as the American types.

Bermuda onions are grown in the extreme southern portions

of the United States where the growing season is long and the climate warm. The transplanting method is always practised in growing them. They have the mildest flavor, tenderest flesh, and are the poorest keepers of the three types here considered.

Green Onions.—Although not as important a crop as ripe onions, green onions are grown in a large percentage of home gardens. They are popular with the home gardener on account of the ease with which they are raised and the short time required for growing them to an edible size. They are grown in the spring to provide a supply early in the season, before the ripe onions can be produced in the garden.

The common method employed in growing green onions is to plant onion sets as early in the spring as the ground can be prepared, and pull the green onions for table use as soon as they are of sufficient size. The time required for growing green onions to a desirable size depends largely upon the size of the onion sets planted. Large sets will be large enough to use in about four weeks, and soon become strong and tough, if not used when ready. Small sizes require six to eight weeks before they reach a satisfactory size.

Onion sets are produced by sowing onion seed so thickly that the bulbs are crowded to such an extent that they grow only to a small size. When onion sets are grown on a field scale, from 40 to 100 pounds of seed are sown per acre, or about 200 seeds per foot of drill. The rows are made from 12 to 18 inches apart. Larger amounts of seed are required on a rich soil and where the rows are close together. The seed are sown and the crop cared for in the same way as if bulbs were to be grown. About ninety days are required for growing the crop, which is harvested about the time the necks begin to dry up and before the stems begin to droop. The tops are removed as the pulling is being done, and all onions above $\frac{3}{4}$ inch in diameter are sorted out and used for pickle onions. Only sizes smaller than $\frac{3}{4}$ inch are desirable for onion sets. The sets are cured by placing them into slatted crates and putting them in a building with good air circulation. After they are thoroughly dried, they are stored in a dry place for future use.

The potato onion produces green onions very early in the season. It propagates itself by means of its vegetative parts, by a division of the bulb. Large bulbs of this onion are planted in the spring or autumn, and about the parent bulb is produced a large number of bulblets or small bulbs. The bulblets are planted in the autumn and produce green onions early the next spring. The date of planting is from October first to fifteenth. The small potato onions are planted 3 inches apart in the row, and the rows 15 to 18 inches distant. It is generally desirable to mulch the rows after the ground is frozen to prevent alternate freezing and thawing, which may seriously injure or even kill the seed and cause it to rot. The mulch is removed in spring as soon as growth starts.

FIG. 104.—The growing of onion seed is a specialized business, as is the production of all other vegetable seed.

Onions from seed are often used before they are mature as green onions. When raised in this manner a longer time is required for growing them than is necessary for the production of green onions from sets. If seed onions are sown

thicker than they should stand, they can be thinned when the onions are large enough to use as green onions.

The perennial or tree onion is very hardy and multiplies itself by producing clusters of bulblets where the seed cluster is formed on the common onion. These small bulbs are generally known as top sets. The top sets and the divided bottoms are both used for raising green onions, the divided bottoms being the larger and earlier producers. The perennial onion is planted early in September in furrows about 4 inches deep with rather loose soil used for covering them. The sets grow during the fall and are almost large enough to use by the time the ground freezes in early winter. The following spring, as soon as the ground thaws and the onion starts into growth, those started from the divided bottoms are large enough to use. Those started from the top sets also soon reach an edible size. Those that are not used as green onions may be left to grow and produce top sets and bottoms to use for planting the ensuing fall. If allowed to remain in the ground and mature, they will be ripe usually by the last of July, and should be pulled and cured before planting again in September. The variety of perennial onion generally grown is the Egyptian, or perennial tree onion.

The multiplier onion which has two or more cores, each of which divides and produces large ripe bulbs if not pulled in the green state, is another form that is grown in a manner similar to that given for the perennial onion.

Ripe Onions.—Ripe onions are grown by:

1. Sowing the seed in the open ground where the crop is matured.
2. Sowing the seed in the hot-bed and transplanting the seedlings to the open ground.
3. Planting sets.

A large percentage of the onion crop of the United States is grown from seed planted directly in the field, and this method is generally recognized as being the best to follow for producing this crop on a field scale.

From Seed.—Ripe onions from seed are produced in the home garden in the same way as when grown on a field scale.

The best soil for onion production is one that is well supplied with an available supply of plant food, is friable, does not pack, is well drained but moist, and that is quite free from weed seed. Large quantities of onions are grown on our level muck lands, which possess many of the soil requisites that are necessary for successful onion culture. In the truck, or home garden, onions are grown successfully on a variety of soils, with the exception of clays or heavy clay loams.

Fig. 105.—Sowing onion seed on muck land with hand drills.

Fertilizing land to be used for this crop is done by the addition of large quantities of manure and commercial fertilizers. The manure is added to the land for crops that are grown previous to the onion, or at least the autumn preceding the season that the seed are planted. Stable manure is very good where it can be obtained cheaply, but is open to the objection of bringing in weed seeds, and the possibility of causing a more rapid spread of the maggot. Commercial fertilizers are used extensively and may be applied broadcast before working the land in the spring. If the land has been cropped for some time, a complete fertilizer is most profitable. On recently cleared muck soils, potash is the fertilizer most needed, and often as much as 200 pounds

per acre of muriate of potash is used in addition to a complete fertilizer. The cost of fertilizers for onion ground will usually approximate $4 to $5 per acre. A fertilizer testing 1 per cent. nitrogen, 8 per cent. phosphoric acid, and 10 per cent. potash used at the rate ot 800 to 1200 pounds per acre, has been found profitable in important onion-growing regions.

The onion is a crop that gives better results when grown year after year on the same land, due to the fact that it requires a few years to get the soil into a proper condition as regards fertility, texture, and freedom from weed seed. With most vegetables, crop rotation is highly desirable, but with this one, which requires a soil that has been put into the right condition through special treatment, the things gained by rotation are more than offset by the losses due to this arrangement.

Fitting the soil is an important phase of onion production, as this crop requires a thoroughly prepared seed bed. Fall plowing is generally preferred in order that the land may be fitted as early as possible in the spring. This is necessary since the onion must be planted as early as possible that it may be well started before hot weather. The fall plowed land is disked, harrowed, and floated as early as the land can be worked in the spring. The above operations are repeated if necessary until a very fine seed-bed is made.

Seeding is usually done with a garden seed drill. The standard distance for planting is in rows 12 inches apart, although in the garden it may be desirable to increase this distance. Where thinning is done, from 4 to 5 pounds of seed per acre are sown. If one has carefully tested seed to plant and does not wish to thin, from $3\frac{1}{8}$ to $3\frac{1}{4}$ pounds per acre will be sufficient. The depth of planting is $\frac{1}{2}$ inch for heavy, moist soils, and 1 inch with lighter soils. A more even and rapid germination of the seed is secured if the soil is freshly stirred just before seeding.

Cultivations are given at frequent intervals, and to a shallow depth, on account of the shallow root system of this vegetable. Tillage is commenced as soon as the plants are up, and is repeated at least once in ten days for about three

months. The double-wheeled hoe is used when the plants are small, having the blades set so that they will cut as close to the row as possible, in order to hold the weeds in check, and thus lessen the amount of hand weeding. After the tops are too high to permit of the use of the two-wheeled cultivator which straddles the rows, cultivation is continued between the rows by means of a single-wheel cultivator or the scuffle hoe. A tool having a large wheel is most desirable, since less injury is likely to be done to the plants with the axle and frame of the machine.

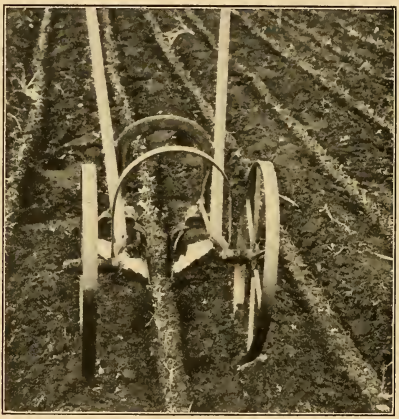

FIG. 106.—The crop is cultivated with a two-wheeled hoe. It should be set to cut close to the row early in the season to reduce the amount of hand weeding.

In addition to the cultivation a large amount of hand weeding is required. It is very important that the grower should keep ahead of the weeds, and this can be done most satisfactorily by beginning early and doing the work frequently. Where there are considerable amounts of weed seed in the soil, it is often desirable to remove the weeds

from the field and burn them soon after they have been pulled. Weed sacks may be carried for collecting small weeds as they are pulled.

Thinning is done at the time of the first or second weeding, before the bulbs are larger than $\frac{3}{8}$ of an inch in diameter. If the plants are thick, thinning should be done early, as they soon crowd one another and the ones that are left to mature are checked in their growth by the ones that are removed. It is best to do the thinning when the soil is moist, and it should be done carefully to prevent injuring the plants that

FIG. 107.—A large amount of hand work is required for growing onions from seed. The thinning is done before the bulbs are $\frac{3}{8}$ of an inch in diameter.

are left. Only the most vigorous plants are left to mature. A distance of at least 3 inches should be left between plants if large bulbs of uniform size are desired. When grown under field conditions, 6 to 8 bulbs are left to each foot of space in the row.

Harvesting the crop in the best condition for storing is done when the onion has been allowed to mature completely in the field. The first indication of ripeness is a shriveling and falling over of the tops while they are yet in a green con-

dition. Soon after the shriveling of the necks, the leaves turn yellow and later become dry and brown. In order to insure getting the crop harvested without a second growth taking place, as a result of heavy rains following their ripening, harvesting should be begun as soon as the tops have fallen over and taken on a yellowish color.

The bulbs are removed from the ground by pulling them out by hand, and they are then piled in windrows with the bulbs all one way, if they are to be topped by hand. Here

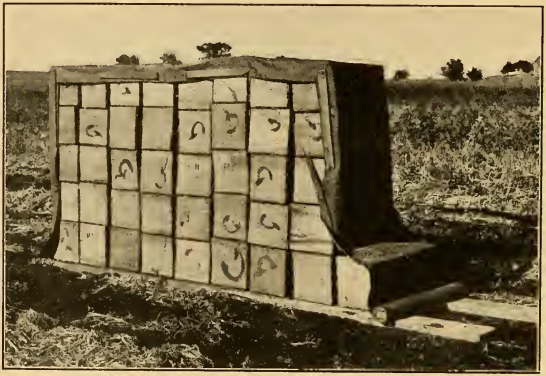

FIG. 108.—One method of curing onions. After the tops are removed the bulbs are placed in slatted crates, piled up as shown above and the drying process completed.

they are left to cure for two or three days or longer if necessary. After the onions have cured sufficiently the tops are removed at a point about ½ inch away from the bulb to avoid injuring it. They are then placed in slatted crates and stored under cover where the drying process is completed.

Another method in vogue in some localities is to twist the tops from the bulbs as the latter are pulled. The bulbs are then dropped into crates or trays and hauled to a curing shed which is well ventilated. In order for onions to keep well

they must be thoroughly cured, after which they may be placed in sacks or crates and stored until sold.

Yields and profits vary greatly and are dependent upon the season and the prices secured. Under fair conditions, an average yield of about 400 bushels per acre is common, although 1000 to 1200 bushels are sometimes produced. An average price to the grower through a period of years is about forty cents, which makes a conservative estimate of $160 income per acre, one-half of which should be profit. Considerably more than this amount is made by experienced growers in favorable seasons and with high prices.

The Transplanting Method.—Transplanting, or the "new onion culture" is being practised with considerable success, since its introduction a few years ago, by some vegetable growers and the home gardener. This method is especially desirable if extra large bulbs are wanted, and is adapted to the growing of foreign types of onions and the Bermudas. In the Northern States the Prizetaker is the principal variety that is grown in this way, although the Gibraltar is of some importance.

The advantages of this method of growing onions are considered to be: early maturity, large-sized bulbs, large yields, uniform stand and size of bulbs, less weeding, and higher prices. It is not always possible in practice, however, to gain all of these advantages by following the transplanting method. The chief drawbacks are: cost of equipment and labor for starting the plants, and the large amount of labor required to do the transplanting. On a field scale, one should attempt at the beginning to set only a small area after this method, so as to become familiar with it, and what is demanded in following it out. It is well adapted to the growing of onions in the home garden wherever hot-bed space is available for starting the plants, and the advantages enumerated above are more likely to materialize on a small area in the garden than on a field scale.

The plants are grown by sowing the seed in rows 4 inches apart in the hot-bed or greenhouse. The difficulties to be encountered are damping off and growing the plants to a large enough size by the time they can be set out. Damping

off is prevented to a large degree by watering but little during dark weather, maintaining a low temperature, and by admitting plenty of fresh air to the growing plants. In order to produce plants of sufficient size for transplanting the seed should be sown in the hot-bed by at least the first week in March. From eight to ten weeks are necessary for growing them to the size of a lead pencil, which is the smallest size that will give good results.

Fig. 109.—Seedling onions or "prickers" are cut back at the top and root when taken from the hot-bed and set in the garden. (The Country Gentleman.)

Transplanting the young seedlings into the garden is done as soon as the land can be fitted in spring. The preparation of the soil is done in a thorough manner just the same as when onion seed are to be sown. The rows are marked out from 1 foot to 18 inches apart, and the transplants set at a distance of 2 to 4 inches in the recently worked soil. A considerable part of the tops and a portion of the roots of the plants are cut away to facilitate planting by having

no long roots to curl upward and to check transpiration by having a smaller top. Onion plants that have had the tops partly trimmed off are more certain to grow after transplanting, because less moisture is thrown off from the reduced leaf surface.

As soon as the transplanting has been completed the land is cultivated and the crop grown in the same manner as when the seed are sown directly in the field, with two exceptions; namely, that no thinning is required, and there is no necessity for early weeding. As already indicated, the success of the transplanting method depends largely upon having well-grown plants of sufficient size and early planting. The transplanting is accomplished with the aid of dibbles for making openings in the soil into which the seedlings are set.

Ripe Onions from Sets.—For the home gardener, the most dependable way of growing onions is by the use of sets. An onion set is a small onion grown from seed the previous year, the small size being secured by planting the seed close together in the row, and allowing the bulbs to mature as best they can without thinning. If sets of a certain variety are desired, it is necessary for the grower to produce them, otherwise they may be purchased on the market and may be had in three colors: white, red, and yellow.

The size of sets to plant depends upon how large they can be used without going to seed. Onions produced from sets that send up seed stalks are valueless as ripe onions. Their keeping qualities are poor and they are coarse and strong. Small sets, although they do not throw up seed stalks, produce bulbs that are average sized, and not unlike those grown directly from seed. The best size seems to be between $\frac{1}{2}$ inch and $\frac{3}{4}$ inch in diameter. Uniform-sized sets are obtained by passing them over a screen with a mesh equal to the size desired.

Pests.—As a garden crop the onion is not seriously affected, but when grown on a field scale on the same land year after year the onion thrip, maggot, cutworm, and onion smut sometimes attack this vegetable. Clean cultivation, cutting off weeds about the fields, destruction of all crop refuse, and fall plowing all aid in holding these pests in check.

For *thrips* spray with a solution of

Nicotine sulphate	5 ounces.
Whale oil soap	5 pounds.
Water	50 gallons.

Compressed-air knapsack sprayers may be used for making the applications. The nozzle should be held close over the plants so that the material will get down in the sheath about the bases of the leaves, where these minute insects work.

The onion maggot is controlled by sanitation and crop rotation when the crop is produced under field conditions.

Cutworms are controlled with the following mixture:

Paris green	1 pound.
Dry bran	1 bushel.

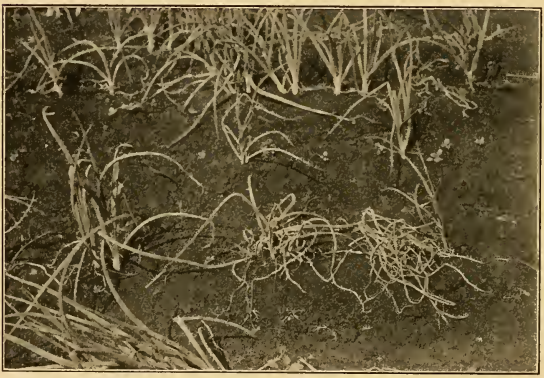

FIG. 110.—The onion maggot attacks the roots and bulbs, causing them to wilt and decay. Destroy affected plants as soon as noticed and practise rotation.

Mix thoroughly and make into a mash with 7 or 8 gallons of water, into which has been stirred ½ gallon of corn syrup or molasses. The mixture should be allowed to stand several hours before use. Apply by scattering, in pieces the size of a marble, in fields where cutworm injury is beginning to appear.

Cutworms usually feed at night. Hence the poison is most effective if put out in the evening.

Onion smut is controlled to a large degree by the use of flowers of sulphur, ground quicklime, or formalin. The formalin treatment is given by using a solution prepared by diluting 1 pound of 40 per cent. formaldehyde with 25 to 33 gallons of water. The liquid is applied by means of a drip attachment to the drill at the rate of 500 to 700 gallons per acre. This disinfects the soil near the seed which permits the plant to grow past the stage when it is generally infected with smut. Ground quicklime is applied broadcast at the rate of 75 to 125 bushels per acre just before seeding.

LEEKS.

The leek is an onion-like plant that resembles a green onion in shape, but is much larger when properly grown. It is used principally as a substitute for onions during the autumn and early winter to flavor different dishes, such as soups. The flavor of the leek is milder than that of the onion, but the flesh is of a coarser and tougher texture.

The crop grows best in a cool season, yet it is able to withstand very hot or cold weather. The soil and cultural conditions required by the leek are similar to those of the onion. The plants are started by sowing seed in early spring in the ground where the crop is to mature. If plants blanched to a considerable height are desired, the seedlings may be transplanted in June or July in trenches 4 or 5 inches deep, which are gradually filled with soil as the plants grow. If not transplanted, soil is pulled up around the growing plants in order to do the blanching. The harvesting is done just before the ground freezes in the fall, and the plants are stored like celery by putting them in trenches, cold frames, or cool cellars.

GARLIC.

This vegetable is used for flavoring food as are leeks. It is very strong, and it is only necessary to rub a small piece of the bulb over the dish that is used as a container for the food that is to be flavored.

The bulbs are compound, having a thin white covering which encloses several small divisions or bulblets, called cloves. The plants are propagated by planting the cloves in early spring 4 to 6 inches apart at a depth of 1 or 2 inches, in rows 1 foot apart. After the plants die down in the fall, the bulbs are harvested, cured, and stored in the same way as are onions.

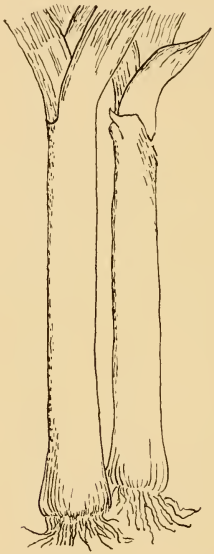

Fig. 111.—The leek is an onion-like plant that resembles a green onion in shape. It is used for flavoring different dishes, such as soups.

SHALLOT.

Shallot plants resemble garlic, except that the bulbs, or cloves, are not enclosed in a thin membrane, but are joined

to the plant at a common base. When the cloves are separated and planted, a new cluster is produced around the parent plant. The crop is grown, cured, and stored like the onion. Its flavor is milder than that of the onion.

Root Crops.—The long season root crops are: carrot, parsnip, salsify, and horseradish. The first mentioned is grown as a short season crop and used in the immature state in early summer, but the main crop requires a long season in which to mature. All of these crops thrive at cool temperatures but will grow through the heat of summer. The parsnip, salsify, and horseradish will also withstand winter freezing and may be left in the garden until spring and then dug and used.

The crops under consideration grow best in a moist, cool, free-working loam that is plowed to a good depth. Soils that are shallow or pack are not suitable. The vegetables of this class are all quite hardy and easy to grow.

CARROT.

The carrot is used when small in the green state and when mature. There are three general types cultivated—the long, half-long, and short-rooted varieties. Those producing short, or ball-shaped, roots are used for early, and the others for main crop plantings. Carrots are grown as a forcing crop in the hot-bed or greenhouse and in the open ground.

Forcing.—The carrot can be forced readily in the hot-bed for early use. The French forcing varieties are most satisfactory for this purpose, and are started in early March. They are usually grown as a companion crop with radish and lettuce, and grow to edible size after these crops are harvested. The roots are pulled and used as fast as they reach a size of $\frac{1}{2}$ inch in diameter at the crown.

Open Ground Culture.—The seed are sown in the garden at a depth of $\frac{1}{2}$ inch and in rows 14 to 18 inches apart. If to be cultivated with horse tools, the rows should be 30 inches apart. The date of planting the early crop is

in the spring, about a week or ten days later than the earliest plantings of radish and onion are made. Carrot plants are more sensitive to cold than the onion or radish. Carrot seed are small, slow to germinate, and the young seedlings are not very strong, which make it desirable to plant radish seed with them to mark the row for early cultivation and to break the soil so that the seedling carrots are able to come up.

The young plants are easily smothered out by weeds, and consequently the crop must be carefully cultivated and weeded until after a good start has been made. In order to have a good stand, it is necessary to sow the seed thicker than the plants are wanted and then practise thinning. The distance to leave between plants depends upon the size of roots desired and the variety. Small to medium sizes require 2 or 3, and large sizes 4 or 5 inches between plants. Medium-sized roots are more desirable for table use, as they are generally more tender and of better quality than the larger sizes. The distance of thinning should be such as to give proper space for the size of root growth desired.

For winter use the roots are harvested before freezing weather and the tops removed. They are then stored in a pit or cellar.

PARSNIP.

The parsnip requires a long growing season and is brought to greatest perfection by winter freezing. Its food value is greater than that of the carrot, but on account of its less varied uses, its consumption is not so general.

Culture.—Quality determines the value of the parsnip root and depends largely upon the careful preparation of the soil which should be deep and rich. The long roots can grow to perfection only in a deep friable soil, and after they have once penetrated to a good depth, they are able to undergo long periods of drouth. A large part of the root development takes place in the fall when the temperature is cooler and the ground is moist.

Parsnip seed do not retain their vitality for a very long period, and only fresh seed should be planted. The seed are sown early in the season about the time the first sowings

of early carrots or beets are made. The seed are drilled in rows 18 inches apart, and the plants thinned to 4 inches apart in the row as early as conditions will permit, since the young roots are not used for food as are carrots. The thinning is much more difficult to do after the roots have grown long and firmly attached themselves to the soil.

FIG. 112.—Parsnips (lying down) and salsify are hardy and the part of the crop for spring use may be left in the ground unprotected. (The Country Gentleman.)

The cultivation and general care of the crop is the same as that of the carrot. Those that are needed for winter use are dug in the fall before the ground freezes solid, and stored in moist sand in a cellar or pit. Considerable care must be taken in lifting the roots so as to avoid bruising and breaking them. This can be accomplished by digging a trench along one or both sides of the row of sufficient depth to extend entirely below the roots which can then be pulled out by hand without injury.

SALSIFY.

This vegetable is commonly known as vegetable oyster, on account of the oyster-like flavor that it imparts to soups and other dishes prepared with it. The plant is hardy and is often left in the ground until spring before it is

FIG. 113. — Salsify or oyster plant roots are used in preparing soups. Its culture is not difficult and it should be more common in the home garden. (The Country Gentleman.)

dug. The leaves of this plant resemble those of the leek. The roots, which are the parts used for food, are from 8 to 12 inches long, straight, light colored, and slightly tapering. The diameter of the mature root at the crown varies from $\frac{1}{2}$ to 1 inch,

Culture.—Since salsify produces a long root a deep, rich soil is necessary for its best development. The seed are sown early, at the same time as are early onions, radishes, and parsnips. They are drilled in rows 12 to 18 inches apart and after the seedlings are up well, they are thinned to 3 inches apart in the row, which gives sufficient space for their full development. The seed are large and of an uncommon shape, having the appearance of dried sticks about an inch long, which makes it difficult to sow them with a drill. On account of the difficulty of thinning, and the high per cent. of germination of the seed it is advisable to sow the seed by hand, placing them just at the distance the plants are desired.

The cultivation and care are similar to that given other root crops planted in drills, and as there are no serious pests which attack this crop, it is not a difficult one to produce. With good care salsify should be mature by the first of October and ready for use. The crop is harvested in the fall and stored, or is harvested in spring as are parsnips.

HORSERADISH.

This vegetable is a perennial, living from year to year by means of underground roots which are not injured by freezing. The most of its growth is made in the autumn when the temperature is cool and the soil moist. Yet it is planted in early spring in order to get a maximum growth. Deep, rich, moist soils with a high humus content are especially desirable for this crop. Badly branched roots result from a too wet or dry soil, or one that is shallow with a hard subsoil.

Culture.—A common practice with many is to grow horseradish as a perennial by planting out roots in a permanent bed. The roots spread, forming new plants each season and as the roots are wanted they are dug and used. The disadvantages with this method are: that the roots are of poor quality, and that the plants often spread so rapidly that they become a serious weed that is almost impossible to eradicate.

The most satisfactory method of producing horseradish in the garden is by the use of root cuttings. These are made from the laterals removed from the main root in the autumn when the crop is harvested. Pieces from 5 to 6 inches in length and about $\frac{1}{4}$ to 1 inch in diameter are generally preferred. The roots are tied in bundles of a desired size, packed in moist sand and stored in a cool place until they are needed. Crowns are sometimes employed for starting the crop, but they produce a number of small branched roots that are difficult to grate.

Fig. 114.—Root cuttings of horseradish. The pieces of roots are planted right end up with the upper end about 2 inches below the soil.

After the land has been fertilized and thoroughly prepared to a good depth, the root cuttings are planted obliquely or perpendicularly in rows 18 inches to 36 inches apart, and 16 to 18 inches in the row. The cuttings should be set right end up to secure the best growth, and with the upper end 2 or 3 inches below the soil surface. Horseradish is especially desirable as a companion crop and should always be grown as such in the garden. It may be planted between early cabbage to good advantage, since it produces the most of its growth in the autumn after the cabbage crop has been harvested. The cuttings are set between the cabbage plants by making openings in the earth with a crowbar or dibble. Thorough cultivation during the long growing season should be given.

If the roots are desired for winter use, the harvesting is

done in the fall. The roots are dug, the tops and lateral roots removed, and then the main roots are stored in moist sand in a cool cellar for use as wanted during the winter. The root cuttings for starting the next season's crop are selected at this time from the lateral roots. These are also stored as previously stated until time for planting in spring.

Roots grown in this way are 8 to 12 inches long, an inch or more in diameter, straight, solid throughout, and of

Fig. 115.—Horseradish roots produced in one season from the root cuttings shown in Fig. 114. Cuttings for the next season's planting are taken from the side roots.

excellent quality. When the crop is dug care is taken to remove all of the root system, which completely prevents the plant from spreading. If the vegetable is not wanted until spring, it can be left in the soil during the winter and taken up when the ground has thawed out.

Perennials.—The perennial vegetables are: asparagus, rhubarb, globe artichoke, sea-kale, and chives. The first two mentioned are the most important ones of this group, although the others have a place in the home garden. Since these crops occupy the same land several seasons it is desirable to locate them together along one side of the garden. When the land is plowed each season the portion occupied by them is omitted most conveniently with this arrangement.

ASPARAGUS.[1]

This vegetable is the most important of the perennial crops. It is a very desirable one to grow in the garden, for it produces its edible parts early in the spring, some time before any other vegetable can be grown. The young succulent shoots which spring from the fleshy roots early in the season, constitute the part of this plant that is used for food purposes. Asparagus has a wide distribution and does well under a variety of conditions. After a bed has once been started it remains in a producing condition for about ten years, with moderate care.

Propagation.—The home gardener may propagate asparagus plants by sowing seed, or he may purchase them from seed firms or gardeners who make a specialty of producing them. If they are to be propagated at home, the seed are drilled 6 to 8 inches to the foot in rows, and the plants cultivated carefully during the first and second seasons. The plants may be transplanted to the garden when but one year old, if they have made a good growth. Some prefer to wait until they are two years of age in order to have a larger root system that will produce soon after transplanting. One-year-old roots of good size and well grown are quite as satisfactory as two-year-old roots, if planted in soil that has been carefully fitted. Asparagus produces a small amount of top growth the first season, although it makes a large number of long, fleshy roots. Give clean culture and two or three light applications of nitrate of soda during the summer to increase the size of the roots.

It is often desirable to purchase asparagus roots for home garden planting, since a crop can be produced one or two years earlier than if seed are planted and plants secured in this manner.

Planting.—It is well to get the soil in good condition before planting the asparagus roots. Plow an inch deeper than usual and turn under a cover crop or manure if possible. Plant early in the spring, and if the roots are grown at home,

[1] New Jersey Circular 57 (adapted).

dig them only as fast as they can be set. If the roots are purchased and arrive before they can be set, unpack and place them in a shady place and cover them with soil to keep them cool and moist.

The field should be marked out very carefully in rows 5 feet, 6 inches apart, possibly a few inches wider if white asparagus is to be grown, or a trifle narrower if the asparagus is to be cut green. These rows may then be deeply furrowed by passing back and forth in each with a two-horse plow.

FIG. 116.—Asparagus roots are planted 6 to 8 inches deep. The roots of the young plants should be spread out and covered with about 2 inches of soil when set.

The roots may be spread out in these furrows 18 inches apart, deep enough so that when the soil is eventually leveled the roots will be from 6 to 8 inches deep, the greater depth for the lighter soils or white asparagus. About 2 inches of soil is put on top of the young roots to begin with, leaving the rest of the furrow to be filled in later in the summer. A light application of well-rotted stable manure, chicken manure or fertilizer may be sowed along these rows after the roots are covered.

Care the First Season.—During the summer frequent cultivations should be given; thus the soil will be kept in a good condition and the furrow will gradually be filled up as the roots become strong enough to force their way up through more soil. Thorough cultivation should be given at all times. In the fall it is a good plan to disk harrow the top growth into the soil especially for the first few years, because then the amount of brush is small. Do not cut the crop for market until the third spring, and then for only three weeks. During the fourth season the patch can be cut until the first part of June, and each year thereafter cutting may continue until the last of June.

Treatment during Cutting Season.—Disk harrow the ground several times in the spring before the stalks begin to come up. Cultivate frequently during the cutting season.

For white asparagus a moderately high, flat ridge should be frequently renewed, with a regular asparagus ridger, to conserve moisture and kill the sprouting weed seed.

If green asparagus is being cut, no ridge is made during the first part of the cutting season. As the season advances, the soil becomes warmer and the sun hotter, tending to cause the tips of the stalks to open up before they reach the desired height. A low, broad ridge prevents this trouble during the last part of the cutting season. If weeds start in the rows about the middle of the cutting season, it may be advisable to disk harrow the field thoroughly in every direction some day just after the last cutting for the week. Thus the temporary setback which follows will come over Sunday.

Care after Cutting Season.—Immediately after the cutting season, disk harrow again, picking up any asparagus tips which are thrown out. Continue to cultivate after the growing season, and when weeds begin to start between the plants in the row take a one-horse plow and throw a furrow from each side of the row against the plants. The heavy stalks of asparagus will not be injured and the small weeds will be completely smothered.

At the end of the growing season the stalks may be mowed down when the berry balls are turning red. The asparagus brush may be raked into windrows and burned or disk

harrowed into the soil. Disk harrowing the field tears out the old stumps and destroys any grass or weeds which may have started. When concluding the harrowing it may be

Fig. 117.—Bunch of Palmetto asparagus.

well to harrow in such a way that there are slight ridges over the rows; thus the plants will be better protected from severe freezing, and if washing takes place, it will occur between the rows, rather than in them. By the method

of cultivation outlined above, the ground is always kept clean and stirred with the least possible effort. There will be no hand work of pulling weeds or hoeing. Such cultivation enables the roots to get full benefit of all soil fertility and moisture. Strong crowns will develop to produce a heavy crop of large stalks the next year. Furthermore, not nearly so much work is involved as in cutting and putting up a bunch of smaller stalks.

Fertilizing.—Moderate applications of manure are generally applied during the fall or early spring. This is usually disked into the soil at once to prevent the soluble plant food it contains from washing away. Manure is expensive, and although excessive applications of it will increase the yield, the net profit per acre from such use may be reduced. Fertilizer is frequently applied at the rate of about 800 pounds per acre of a mixture high in nitrogen. This is usually disked into the soil during the late spring. The most successful growers apply 200 pounds of nitrate of soda per acre immediately after the cutting season. It is quite advisable to apply at the same time 200 to 300 pounds of agricultural salt per acre, especially if potash is high priced. Lime may be used to advantage provided the soil is very sour.

Harvesting.—Asparagus is cut with a knife especially designed for the purpose. When cutting green asparagus, go below the surface only as much as it is necessary to get the stalks of the desired length of about 9¼ inches; 5 inches at least of these stalks should be above ground. White asparagus is cut far below the tops of the ridges as the tips appear. The cutter should take care lest other stalks which cannot be seen become injured in cutting. After cutting, the product is promptly removed to the house in order to get it out of the air.

The cutting period begins as early in the spring as the shoots are large enough, and with a well established bed extends over a period of six weeks. Too long cutting reduces the yield for the next year by preventing the plant from storing sufficient food in the fleshy roots. All shoots should be kept cut during the cutting season. If any are allowed to grow, the plants soon cease producing the succulent stalks.

Pests.—Asparagus beetles frequently become destructive during both the cutting season and late summer. During the cutting season, millions of beetle eggs may be destroyed if the cutters are careful to remove every spear to the packing sheds. If the old beetles become especially destructive, a few scattering hills may be left to grow. These should be

FIG. 118.—Cutting asparagus. White stalks are secured by cutting several inches below the soil surface soon after the tips have appeared. (The Country Gentleman.)

kept coated with arsenate of lead, 1 pound of paste to 12 gallons of water, so that when the adult beetles accumulate upon these, they will be poisoned as they eat. If it becomes necessary to check the attacks of the beetles during late summer, it may be advisable to spray with a solution consisting of 3 pounds of arsenate of lead paste, 3 pounds of resin fish oil, and 50 gallons of water.

The rust has become of minor importance in recent years, especially where Palmetto asparagus is grown. Some observers say that rust is more frequently injurious on very sandy or poor soils.

RHUBARB.[1]

Rhubarb, or pie plant, produces large leaves with fleshy stalks, the latter forming the edible part. The leaves and stalks are produced during the early part of the season, and it is at this time that the stalks are most in demand. After early summer, the leaves are allowed to grow and provide the roots with food to store up for producing the next year's crop.

Climate and Soil.—Rhubarb is naturally a cold-weather plant and is expected to make a luxuriant growth of leaves with thickened leaf-stalks early in the spring, consequently it must feed in a quick-responding soil. Locations where snow and ice are liable to linger during the spring should be avoided. A site on early ground, with a southern exposure and a slight slope for drainage, is desirable. A rich soil, mellow to a considerable depth, is of great importance for a good commercial plantation. The site should be well drained, but the soil rich in humus and of a retentive nature, so as to retain the large amount of moisture required by the rapid-growing stalks.

The soil should be well prepared before starting the plantation, especially if not thoroughly mellow, by growing a crop like potatoes on the site for a season, with liberal amounts of stable manure to supply humus and enrich the soil. The soil can hardly be made too rich. Deep stirring of the soil before planting is essential—the deeper, the better. Sites infested with quack grass should be avoided or thoroughly cleared of this bothersome weed before setting rhubarb.

Propagation.—Rhubarb propagates by root divisions or by seed.

The root method is considered by some to be an expensive one, but is highly desirable in order to secure uniformity of

[1] New York Agricultural Exp. Station, Circular 38 (adapted).

the product. Where the grower already has a number of healthy plants growing on his place he may dig them up and separate the root clumps which have formed at the base of the plants and start the new plantation from these without great expense. In dividing the roots care should be taken to obtain a piece of the crown on each division of the root clump. Strong, healthy and vigorous roots should be selected for planting; and poor, half-developed roots should be discarded, in order to give the plantation a good start under favorable conditions.

Some growers prefer to propagate from seeds because these may be obtained so much cheaper than roots. But rhubarb plants grown from seed require one year longer to come to maturity than those grown from roots; that is, it will require three years from the time of sowing for the plants to become firmly established in the ground. The first harvesting of leaf-stalks will thus be delayed until the spring of the fourth year. Also, rhubarb does not always come true to type from seed, only about 15 per cent. of seedlings usually being true to the variety, and therefore more or less variation among the plants, as to size of stalk, etc., may be expected. This irregularity can be only partly avoided by selecting the plants having the most uniform characteristics. The seeds are sown early in the spring and are usually drilled in rows about 18 to 36 inches apart and about 1 inch deep. About ½ ounce of seed should be used for 100 feet of drill. The young plants should be thinned to about 8 to 10 inches apart in the row. The year following the seeding, when the plants are one year old, they are ready to be set in permanent positions.

Planting.—When the site of the plantation has been thoroughly worked and the ground is mellowed to a good depth it is ready for planting. This is usually done in the spring, although successful results may be obtained from fall setting. A heavy application of manure at the time of planting is desirable. This may be placed directly on the hill, but it is best to mix it with soil when it is put near the roots. The roots should be set deeply if they are to remain as a permanent plantation so that the crowns may be covered with from 2 inches to 3 inches of soil. The distance for planting varies

somewhat with the variety, since some varieties grow larger than others. Where cultivation is to be only in one direction the rows may be from 4 to 6 feet apart with the plants 3 feet apart in the rows. When planted 4 feet apart in the rows with the rows 4 to 6 feet apart the plantation can be cultivated both ways.

Cultivation and Fertilization.—Rhubarb seedlings and young plants should be given good surface cultivation throughout the season, chiefly to prevent the growth of weeds and to keep the surface mellow. It should not be deep enough to injure the roots. Every fall a heavy coating of well-rotted stable manure should be applied. This free use of manure should not be neglected, for therein lies one of the secrets of success in rhubarb culture. Commercial fertilizers will not take the place of stable manure. In the spring the manure is forked away from the plants and a thorough cultivation given the land, turning the manure under. Some growers have found it profitable to use nitrate of soda in addition to stable manure, scattering it, in the spring, on either side of the row at the rate of about 100 pounds to the acre. After turning under the manure, cultivation is withheld in the case of a mature plantation, until the harvesting time is over to avoid injuring the crop. Cultivation is resumed as soon as the stalks are harvested, to mellow the soil and keep out weeds.

Renewal.—If after four or five seasons the plants appear to be running down, it is generally an indication of too great root growth; and the root clumps should be divided. These may be dug up in the fall; or some of the roots chopped off by spading around the plants. If a portion of the crown be left on the surplus roots cut off, they may sometimes be sold. Some growers simply plow up close to the plants in the fall and thus cut off some of the roots from the clumps. This need be done only once in every four or five years when the plants seem to require it.

Harvesting.—In root-set plantations the plants should be in a sufficiently vigorous condition in the spring of the third year to permit harvesting a light crop. Only the largest full-grown leaves should be taken—generally the outer leaves of the plant. All of the younger leaves, which are usually toward

the center, should be left to maintain the plant through the summer; and at no time should anywhere near all of the leaves be removed. In picking, pull straight upward and at

FIG. 119.—Rhubarb stalks are harvested by pulling straight upward and at the same time applying a slight sidewise twist. (The Country Gentleman.)

the same time apply a slight sidewise twist to the stalk, which should separate readily from the crown without breaking and without injuring the plant. Flower or seed stalks should be cut out as fast as they appear.

Forcing.—Forcing of rhubarb has become quite common with many growers and various means are employed to produce a winter or early spring crop. Wholesale growers usually have a specially constructed cellar which is heated by a stove or by steam. The space under greenhouse benches is sometimes used to good advantage for this purpose. The process of forcing is simple, as heat and moisture are the two requisites. Rhubarb does not require light for stalk growth, consequently a dark cellar or shed will do as well as a sunny greenhouse, if the right amount of heat can be supplied. For family use the roots may be planted in a box and placed in a warm cellar or attic. On a larger scale one may use all available space in the cellar or any shed which can be heated with a stove. Deep earth is not necessary for forcing and the soil can be placed on the floor. Root growth is very slight during the forcing process and the soil is provided chiefly for the purpose of supplying moisture to the roots.

In forcing, practically all of the food used by the growing stalks comes from the supply already stored in the roots before planting in the forcing bed. For this reason, good, large, well-fed roots, at least two or three years old should be selected for forcing. These may be taken from the frozen ground and placed in the forcing bed, or dug in the fall and allowed to freeze in open sheds or in the field where coats of straw or leaves are put over them to prevent alternate freezing and thawing. Roots do not need to be in a frozen condition when planted in the forcing bed, but previous freezing is necessary for the production of good yields.

The roots may be packed closely together in the forcing bed and the soil should be packed under and between the clumps of roots so that the crowns are about level with the surface. Growth will begin as soon as the proper conditions of heat and moisture are supplied. The temperature may range from 40° to 75°, but the rapidity of growth of the stalks is almost directly proportional to the heat supplied. Hence, the ripening of the crop can be hastened or retarded, to a considerable extent, by regulating the temperature. On the average it requires about five weeks to mature a crop from the time of planting in the forcing bed. The lower temperatures

and slower growth give a better product and greater yields, 50° to 60° being most generally recommended.

Forcing is naturally a heavy drain on the roots and if they are to be used at all for resetting they should be removed from the forcing bed upon the first signs of slackening in growth. If given proper care the roots will regain their vigor in the plantation in two or three seasons. A new supply of roots should be used for forcing the next season. In order to secure a succession of forced rhubarb, roots must be brought into the warm cellar at intervals of three or four weeks.

Rhubarb forced in the dark has a very attractive appearance, the stalks being a bright crimson color while the leaf blades never fully develop in size and remain a bright yellow. The crop is harvested and handled the same as the outdoor crop, except that in preparing for market the lower portion of the blanched leaf blade is left on the stalk as an attractive feature. The quality of forced rhubarb is very good, the stalks being very tender and of a flavor slightly less tart than normal growth. Because of the simplicity of the process and the value of the product it is recommended that forcing rhubarb be given more attention.

GLOBE ARTICHOKE.

This vegetable is not commonly found in American gardens. The fleshy base of the unopened flower heads, which are about four inches in diameter, are the portions of the plant used for food. They are eaten in the raw or cooked state. The crop does not grow so well in the North, although with proper attention it may be grown to a limited extent on the rich black soils of the corn belt States.

Culture.—This plant is propagated from seed, suckers, or divisions of the roots. The most satisfactory way of getting a start is to sow the seed in the hot-bed in early March, and prick off the seedlings into pots or dirt bands when about four weeks old. The plants are set in the garden the latter part of April, at a distance of 4 feet between plants and in a rich soil made so by heavy manuring. If started early a crop may be expected the first year.

This plant must be given winter protection in order for it to survive the low temperatures of our Northern climate. Protection is accomplished by placing a foot of earth over the crowns of the plants in late fall and if severe weather is common, a layer of manure or leaves is also added. In early spring this covering material is removed, after which the plants soon begin to grow, if they have not been killed during the winter.

Fig. 120.—Globe artichoke. The fleshy base of the unopened flower heads are the portions of the plant used for food. (The Country Gentleman.)

The globe artichoke does not come true to seed, and consequently it is desirable to start a new bed by the use of suckers, if they can be obtained. These are taken only from plants of a type that is desirable. A small portion of the crown is taken from the parent plant with each sucker, in

order that roots will be produced readily. The suckers are taken in early spring at the time the covering is removed and are planted in the garden.

In order to have strong thrifty plants, thorough cultivation should be given and new plantings made every three or four years. Winter protection should also be given every season.

The Jerusalem artichoke is entirely different from the globe artichoke, belonging to a different botanical family and producing an edible tuber. The plant is grown for human food, but is in more general use as stock feed, especially for swine. A plantation is started by planting the tubers in the same way as the Irish potato. After it is well started it will maintain itself for several years.

SEA-KALE.

Sea-kale closely resembles asparagus, and although not common in America, is quite popular in England. The parts used consist of the large succulent leaf stalks which spring up from the crowns very early in the season before asparagus is producing edible shoots. The edible portions are used as a substitute for asparagus.

Culture.—Sea-kale is grown from seeds or root cuttings. When seed are used they are sown in a seed-bed in the open or in a slow hot-bed. In the seed-bed the rows are 18 inches apart and the young plants thinned to a distance of 6 inches apart in the row. Hot-bed-grown plants are set out in the garden at the above distances as soon as the plants are of sufficient size to be readily transplanted. During the first season good care is given in the seed-bed to keep the plants in a thrifty condition. At the beginning of the second season the plants are set in rows 3 or 4 feet apart with the plants about 3 feet distant in the row. The crop is cut two years from the time of setting out.

Root cuttings are also used for starting plants. These are taken from branches of the main root in the same way as are horseradish root cuttings. The cuttings are made from 4 to 9 inches long and if cut in the fall are tied in bunches and stored by packing them away in moist sand during the winter.

Spring cuttings are planted directly in the soil. The roots are set like horseradish, except that they are placed one inch below the soil surface instead of two or three. Two years after the time the plants are set a crop may be expected.

The production of seed is prevented with this crop by cutting out the flower stalks as they appear. Seed production weakens the strength of the plant and is only permitted when seed are wanted for planting. Sometimes the weaker stalks are removed if they come in large numbers, in order to encourage the development of large stalks. Dressings of manure each fall also aid in producing vigorous growth.

FIG. 121.—Sea-kale comes earlier in the season than asparagus. The large succulent leaf stalks are used as a substitute for asparagus. (The Country Gentleman.)

Blanching is practised with the leaf stalks to make them white and to remove the bitter flavor. Applications of litter or loose sand, or the placing of pots over the crowns are common methods of excluding the light so that the stalks will be blanched.

CHIVE.

The chive or cive is a native of Europe and the northern parts of the United States. This vegetable is a perennial

onion-like plant grown for its slender awl-shaped, erect, hollow leaves which grow in dense clusters from a mass of interlacing roots. The leaves are about an eighth of an inch in diameter and are used for flavoring purposes. The plant does not form large bulbs as does the onion, but possesses many points of similarity. The plant is propagated by dividing the root systems in early spring, or by the use of seed which are planted at a depth of $\frac{1}{2}$ inch. The plants are

FIG. 122.—The chive is a perennial onion-like plant having slender awl-shaped leaves which are used for flavoring purposes. (The Country Gentleman.)

grown in rows 12 inches apart, and the clumps at a distance of 6 to 12 inches apart in the row. The roots should be divided and replanted every three or four years, in order to keep them in a vigorous condition. The tops are clipped close to the soil quite frequently during the early part of the season, to keep the leaves young and tender. If desired for winter use, a few clumps may be dug in the fall and stored in a cold frame. Cuttings are made the next season after the clumps are set.

CHAPTER XV.

SHORT, COOL SEASON CROPS SOWN IN THE OPEN GROUND IN EARLY SPRING AND MATURING QUICKLY.

The crops coming under this group require but a short season to mature, and consequently are seldom transplanted. In normal seasons in northern and central latitudes they mature before hot weather if planted as soon as possible in early spring. With the exception of early potato they are all unable to endure summer heat, and all of them thrive at a low temperature.

Root Crops.—The cool season root crops that are planted in the open ground in early spring and mature quickly are: radish, turnip, beet, and rutabaga. Of these, the radish is most universally grown and the most popular. All of them prefer a deep, moist loam soil and a cool temperature. They may also be grown in the autumn when the weather becomes cool if so desired.

RADISH.

The radish is one of the quickest maturing short season crops. Its quality depends largely upon the rapidity with which it grows. If the soil is unsuitable and the plant grows slowly, the roots are sharp, tough, and often pithy.

Radishes are classed according to season into Spring, Summer, and Winter varieties. There is a variety of root shapes and colors under each of these classes. The shapes are: turnip, olive, globe, half-long, and long, and the colors: white, red, crimson, scarlet, black, and yellow.

The spring varieties are small, round, or turnip-shaped, are planted in early spring, and mature in four to six weeks. As a class, they are of very high quality. The summer varieties

are planted in May, are long rooted, and furnish a supply of this vegetable during the heat of summer when the spring sorts cannot be grown. The winter varieties are long rooted and are planted from mid to late summer, and produce the most of their growth in the autumn. The roots which grow to a large size are dug in late fall and stored in moist sand in a cool place for winter consumption. The summer and winter radishes grow to a large size, especially the latter, one being

FIG. 123.—Varieties of garden radishes: 1, French breakfast; 2, white icicle; 3, white Vienna.

large enough for a family meal. They are both peeled before using in order to remove the coarse skin and the pungent portion just below it.

Culture.—Early radishes are generally planted as a companion crop with some other vegetable requiring a longer period for maturing. They are good for marking the rows for early cultivation, and for breaking the crust on the surface so that less vigorous plants growing with them may be able to come up.

A "quick" soil that is rich and easily worked is best for this vegetable. Thoroughly rotted manure may be applied if the land is low in fertility.

Experiments have shown that large seed give best results. Those less than $\frac{2}{25}$ inch in diameter are of no value and should be screened out and discarded.

Radishes are sown in drills from 10 to 18 inches apart, at a depth of $\frac{3}{4}$ inch and with about 30 seeds per foot. After sowing, the soil should be firmed well about the seed to bring the latter in complete contact with the soil. The spring and summer varieties are thinned to 1 or 2 inches, as the first specimens reach edible size and are harvested. The winter varieties are planted in rows 18 inches apart and are thinned early to a distance of 5 inches apart in the row if large specimens are desired.

TURNIP.

The turnip occupies a rather lowly position as compared with the other vegetables usually grown in the home garden. On the farm it is more generally grown as a winter feed for stock. For table use it is grown either as a spring or fall crop. The white-fleshed sorts are preferred over those having yellow flesh. The shapes commonly grown are: oblate, oval, conical, and spherical, the latter shape being generally preferred.

Culture.—Turnips grown for early spring use are grown somewhat differently from those produced for fall or winter consumption.

Spring turnips are sown early in the season as soon as the ground can be fitted, in order that they will reach an edible size before hot, dry weather approaches. This requires from 6 to 8 weeks in open ground culture. Early turnips are grown for immediate use and consequently only a small area need be planted for the average family.

The seed are planted $\frac{1}{2}$ to $\frac{3}{4}$ inch deep and in rows 12 to 18 inches distant for wheel-hoe cultivation, and 30 inches for horse cultivation. Too thick seeding makes too much thinning, and if good seed are being planted, one seed to each inch of drill will be sufficient for getting a good stand. The

plants are thinned to $2\frac{1}{2}$ or 3 inches apart in the row. The thinnings are sometimes used for greens.

Fall turnips are commonly grown as an incidental crop to be stored for winter use. They are sown as a succession crop after early beets, potatoes, peas, and beans. The seed are generally broadcasted about August first and harrowed in, the seed-bed having been prepared very thoroughly in advance of the sowing. Grown in this manner, the expense is slight

FIG. 124.—High quality in winter turnips is secured by planting them late so that they will not reach full size before storing. (The Country Gentleman.)

and the yield large, although the roots are not of as uniform a size as when grown in rows and thinned. The roots are hardy and will stand frost, consequently are harvested and stored just before heavy freezing sets in.

The turnip, like the other short season root crops, requires a constant moisture supply, cool weather, and a rich, loose soil.

Rotation of crops is desirable to aid in controlling the root maggot.

BEET.

The beet is a widely distributed vegetable and is grown for greens, bunch beets, and for winter use in the mature

state. The types in cultivation are garden beet, Swiss chard, sugar beet, and mangel. The garden beet is the one commonly referred to. The mangel is grown for stock feed, the sugar beet for the production of sugar, and the Swiss chard for the food value of its leaves.

Culture.—The culture of the beet is similar to that of the carrot. The seed are in reality fruits containing 3 or 4 seed which make thinning imperative. The seed are planted from $\frac{3}{4}$ to 1 inch deep and the plants thinned to a distance of 3 to 6 inches apart, according to the size of root desired.

Since the beet plant is quite hardy, the seed are planted in early spring for early use. The thinning is done when the first beets are large enough to use for greens. The remainder are harvested as they reach edible size and are wanted.

The beet is easily transplanted and may be started in the hot-bed and transferred to the garden if desired very early in the season. It may also be grown as a forced crop in the hot-bed or greenhouse.

SUGAR BEET.[1]

Sugar beets are seldom grown as a garden crop, but no book of the vegetable crops would be complete without some discussion of their culture. The production of sugar beets is limited to regions that are particularly adapted to them, where beet-sugar factories have been erected. The process of extracting the sugar from the beet requires a large establishment. It cannot be done profitably on a small scale. The principal sugar-beet-producing States are Colorado, California, Michigan, Idaho, Utah, Wisconsin, Ohio, Indiana, and Illinois.

In many farming regions the growing of sugar beets has proven a profitable farm practice. The crop is most commonly grown on level soils of a black loam or muck type.

Soil.—It is generally conceded that the best soils for the production of sugar beets are the sandy loams and the clay loams. However, any good soil if properly handled will pro-

[1] Farmer's Bulletin 568.

duce satisfactory sugar beets, provided the climatic conditions are favorable. In general, more depends upon the physical condition of the soil and the way in which it is worked than upon its strict classification. The physical condition of the soil depends upon a number of factors which are of prime importance in the selection and preparation of the ground for sugar-beet growing. For example, the soil should be well drained and at the same time it should be capable of holding a sufficient amount of moisture for the needs of the beets. Even the so-called muck soils will produce good beets if they are well drained and properly worked. On the other hand, the loamy soils will sometimes produce very poor crops if not well drained or if otherwise improperly handled.

For the retention of sufficient moisture for crop production the supply of humus plays an important part. A soil that is well drained and at the same time properly supplied with humus will not only hold enough moisture for the needs of the plants, but it will permit the air to circulate through it and enable the soil organisms to thrive and multiply, thereby liberating an abundance of plant food.

The nature of the subsoil has an important bearing upon the selection of soil for sugar-beet growing. Hardpan subsoils should be avoided, especially if they are so near the surface that they will interfere with the proper growth and development of the roots. Likewise, the very porous or gravelly subsoils which permit of rapid leaching will not give the best results with sugar beets as for other crops, because the moisture passes down too rapidly and not enough is retained in the soil proper to supply the needs of the plants. At the same time, if there is an abundance of rain on such soils, so that the plants are seemingly well supplied with moisture, the soluble plant food, the only kind which is of any use to the plant, will be washed out and to some extent lost. The disadvantages of a porous subsoil may be overcome in a measure by furnishing the surface soil with a good supply of humus and giving it such tilth that as much of the moisture as possible will be retained in the surface soil. In selecting soils for sugar beets, therefore, careful attention should be given both to the soil proper and to the subsoil. In general,

if a soil has been producing good crops of corn, potatoes, etc., it will produce good beets, provided it receives the proper preparation and cultivation. In selecting a field for sugar beets it is advisable, therefore, to note the kind of soil and its condition, especially with reference to drainage and humus, the kind and quality of the preceding crops, and the nature and location of the subsoil.

The field selected should be reasonably free from weeds, since extreme foulness of ground adds very materially to the cost of growing beets. The beet field must be kept free from weeds if one expects to obtain anything like satisfactory results. It is sometimes claimed that a beet crop is of great advantage in freeing a field from weeds. This is true if the ground is properly handled, but one should see to it that not too large a percentage of the profits of the crop is consumed in fighting the weeds, a condition which may be avoided by careful attention to the preceding crops with respect to weed growth. This emphasizes again the importance of personal knowledge of the individual field. This knowledge the farm owner acquires either consciously or unconsciously if he works his farm intelligently and is a fairly close observer, but the tenant who is constantly shifting from one farm to another is handicapped in that he lacks this personal knowledge of the individual fields, which he should have in order to locate his crops to the best advantage.

Climatic Conditions.—The principal climatic conditions which have an important bearing upon sugar-beet culture are temperature, precipitation, and winds. Other things being equal, an average temperature of about 70° F. during the growing season will usually give the best results so far as the sugar content of the beets is concerned. If the average temperature is very much above this point, sugar does not seem to form readily, and consequently the beets are of poor quality. On the other hand, if the temperature is too low the beets do not grow well and the tonnage is correspondingly low. Aside from the temperature of the growing season, the spring and fall temperatures have much to do with the success or failure of beet culture. Late spring freezes following a favorable period for planting and germination will fre-

quently destroy the young plants and involve considerable extra expense and labor in replanting. A protracted cold spell after the seed is planted will retard germination and growth and often give the beets a set-back, from which they frequently fail to recover fully. A well-drained soil, rich in humus, will tend to offset these adverse conditions to some extent.

FIG. 125.—An undesirable type of sugar-beet root. (The Country Gentleman.)

Cool nights and moderately warm days in the latter part of summer and in the fall are most favorable for the storage of sugar in the beets. The great danger from extreme cold in the fall is that the beets may be frozen in the ground. This sometimes occurs and causes considerable loss to the grower. Every grower should aim to get his beets out and, if necessary, siloed before freezing weather sets in. If the roots themselves freeze, no great amount of damage will result, provided they

remain frozen until they are worked through the mill, but if they alternately freeze and thaw, they will soon blacken, decay, and become worthless for sugar-making purposes. Frozen beets should not be put into the sheds with the expectation of leaving them for any length of time, as they will certainly spoil. The only safe way is to get the beets out of the ground before they freeze and put sufficient covering over them so that they will not be frosted.

FIG. 126.—A compact, stocky root that is more profitable than the one illustrated in Fig. 125. (The Country Gentleman.)

The amount of precipitation in the form of rain or snow which falls in a given area is beyond our control, but considerable can be done toward getting the full benefit of the precipitation, whether it comes in summer or in winter. If the ground is plowed deep in the fall and left rough, the snow will not blow off, and as it melts it will sink into the ground, where much of it may be held for future use. A good supply of

vegetable matter in the soil together with proper tillage will aid materially in holding the moisture, while proper drainage will carry off any excess of water which might be injurious to the plants.

In most of the humid regions where sugar beets are grown winds do little, if any, damage to the sugar-beet crop. But in some areas lying close to the irrigated sections wind control is an important problem, and, indeed, is sometimes the limiting factor in sugar-beet growing. In some of these areas the rainfall would be sufficient to produce a good crop of beets were it not for the hot winds in spring and summer, which frequently increase the evaporation to an abnormal extent. Windbreaks, an abundant supply of humus, and good dirt mulches on the surface of the fields will largely offset the bad effects of these winds. In addition to the influence that these winds have upon evaporation they frequently do considerable damage in blowing the seed out of the ground before it germinates and in cutting off young plants soon after they come up. To prevent this as far as possible, the surface of the fields in these areas should not be too smooth, but should be kept slightly ridged and somewhat lumpy.

Breaking.—There are two important points in plowing for sugar beets that should be kept in mind, namely, the time and the depth. Experience has demonstrated that the best results are generally obtained by plowing the ground for beets in the fall. Taking advantage of this fact, the beet grower will try to arrange his work and his crop rotation so that he can plow his beet ground in the fall, provided the soil and weather conditions will permit.

The advantages in fall plowing are numerous and distinct. In the first place, if the ground is plowed in the fall under proper conditions it will be in better physical condition in the spring because of the fact that the weather has had free access to the soil particles and put them in better shape to part with the elements necessary for plant growth. Fall-plowed land also tends to take up more readily the winter rains and snows that fall upon it. This precipitation not only helps to put the ground in better condition for a crop, but it may be made to supply a large amount of moisture

to tide over dry periods that are almost sure to come every spring or summer. If the ground is plowed in the fall that much work is out of the way and the rush of work that is always present in the spring is greatly relieved. Fall plowing also enables the farmer to work down his ground earlier, thereby holding more moisture and putting his soil earlier in condition for his crops.

There are, of course, conditions under which fall plowing is impracticable, either because of lack of time or because the condition of the ground makes it impossible. Every farmer of experience knows the injurious effects of plowing ground when it is not in the right condition to be worked. If for any reason spring plowing becomes necessary, it is even more important that the ground be in proper condition as regards moisture when plowed in order to make satisfactory seed and root beds.

The depth of plowing is fully as important as the time. It has been demonstrated again and again that deep plowing will give the best results for sugar beets, other things being equal. If the ground is plowed in the fall it is hardly possible to plow too deep, provided the ground is in condition to be plowed at all. If the plowing must be delayed until spring it is not advisable to plow more than 1 or 2 inches deeper than the ground was previously plowed, since too much raw soil on the surface does not make a good seed-bed. It is assumed that the plowing is done with a moldboard plow, which is the implement commonly used in humid regions. If, however, the plowing is done with a disk plow the ground can be stirred to a greater depth even in the spring without injury to the seed-bed. This is due to the fact that the disk plow has a tendency to mix the top and bottom soils without bringing so much raw soil to the surface as is done with the moldboard plow.

The practice of subsoil plowing for beets is not so common as formerly. Experiments as well as field tests indicate that the extra expense of subsoiling is not generally justified. There are instances, however, in which this operation should not be omitted. For example, if the plowing for any reason cannot be over 7 or 8 inches deep and the subsoil is so hard

that the beet roots can penetrate it only with difficulty, the action of the subsoil plow will be beneficial and should not be neglected.

The whole object of plowing should be to make a deep, rich seed and root-bed which can be penetrated easily by the beet roots and from which the plants can draw an abundant supply of food necessary for their constant and rapid growth. At the same time, the seed-bed must be firm enough to hold the plants securely in place and not so compact that the air cannot circulate freely through it. The depth of plowing should be as nearly uniform as possible throughout the field, and the plow should be set so that the entire surface area of the field is turned.

Fitting Seed-bed.—Plowing is only one step in the preparation of the seed-bed for beets, and unless the subsequent fitting of the ground is done with intelligence and care it matters little whether the plowing is deep or shallow. In fact, unless the grower is prepared to work down the soil into a firm seed-bed it is better in most cases to plow shallow. It is assumed, however, that the grower wants the best possible seed-bed for his beets. If so, he will plow the ground to a good depth in the fall and begin at once the preparation of the seed-bed.

If the seed-bed is carefully selected and thoroughly prepared, the success of the crop is more than half assured. As already indicated, the seed-bed is not only the storehouse which is to supply the plants with food material and moisture but it must be a medium for holding the plants firmly in place during the growing season. The root must be constantly in contact with the fine moist particles of soil; otherwise it cannot dissolve and take up the mineral elements necessary for the growth of the plant. The root needs also a certain amount of air, and the soil should therefore be in such physical condition that the air can circulate freely through it. At the same time no air spaces of any appreciable size should be allowed to remain in or below the seed-bed. Air spaces are detrimental in that they allow the seed-bed to dry out too rapidly and do not permit a sufficiently firm and uniform medium for the proper growth of the plants.

The primary aim, therefore, in fitting the seed-bed for beets should be to make it deep, fine, and firm. If the ground was thoroughly worked for the preceding crops and is in proper condition when plowed, the subsequent fitting of the seed-bed will be much easier. If the ground is plowed in the fall, the winter rains and snows will tend to make it sufficiently compact. If the plowing is done in the spring, or if the nature of the soil is such that it will not be sufficiently firmed by the natural elements, the plowing should be followed by a subsurface packer. It is not sufficient to pack the surface of the ground only, which is so frequently done, but the lower part of the seed-bed, which is, strictly speaking, the root-bed, must be thoroughly firmed. In the spring, as soon as the ground can be worked, it should be harrowed or disked. If the field is free from weeds a good harrowing to hold the moisture will be sufficient, but if the weeds are starting, it will be best to double-disk and then harrow. The roller is a useful tool in firming the surface of the seed-bed, and the alternate rolling and harrowing of the field will usually put it in good condition for planting, provided the lower part of the seed-bed has been well firmed by either natural or artificial means.

Care should always be taken never to work the ground when it is too wet, as that invariably injures the texture of the soil, prevents the free circulation of the air, and renders the formation of a first-class seed-bed impossible. The object sought, namely, the making of a deep, firm, well-drained, well-aërated, moisture-holding seed-bed, should be kept in mind, and the methods employed and the tools used in securing the desired results must be governed to some extent by the condition of the individual field.

Drainage.—Drainage is one of the important factors in beet growing in humid regions, as it is an important factor in the production of all kinds of crops under all conditions. Drainage is of two kinds, natural and artificial. Natural drainage may be due to the porosity of the soil, which allows the water to pass through it readily, or it may be due to the slope of the surface soil or the slope of the subsoil. Naturally drained soils may or may not be good crop producers. If the

water passes through or off from the soil too rapidly the fertility is liable to be leached or washed out to such an extent that the soil is deficient in humus and lacking in the required amount of moisture for crop production.

Soils may be drained artificially by means of the open ditch or the blind ditch. In most beet-growing sections the land is too valuable to admit of the use of the open ditch to any considerable extent, except under some conditions as outlets for the blind ditches. For this reason the blind ditch in which tiles are commonly used is the most general method employed in artificially draining beet land. No invariable rule can be given for the depth at which tiles should be laid, but in general they should be deep enough so that they will not be disturbed by deep plowing, and at the same time near enough to the surface so that the water will readily find its way into them. The depth must therefore be governed by the nature of the soil. The hard subsoil which holds the water and causes undrained soil to become water-logged should be deep enough to allow the tile to be laid at or near the surface of this water-holding stratum without being disturbed by the plow; otherwise the conditions are not good for beet growing. The tiles should form a continuous, but very gentle slope and should be large enough to carry the water off readily. The rows of tile should be sufficiently close to drain the entire water-logged area.

While sugar beets are hardy and thrive under many adverse conditions, there is no crop that responds more readily to good drainage, and therefore the initial cost of artificial drainage for sugar beets is a paying proposition which leaves the land in better physical condition for other crops.

Distance of Planting.—In experiments conducted for a number of years at different places in which the distances 20, 24, and 28 inches were used, it was invariably found that the most profitable distance was 20 inches, everything considered. It is true that the narrower rows require more work because of the larger number of rows per acre and greater care in cultivation, but in all cases the extra expense was more than offset by the heavier yield, even though the individual roots were sometimes smaller. In a few experiments 18 and

22 inches were tried, but the results did not differ materially from the 20-inch rows. Considering the yield as compared with the cost of growing the beets with different widths of row, 20 inches is most generally satisfactory. One argument in favor of the wider row is that the grower in using the wide row is able to utilize a corn cultivator and thereby avoid the expense of an extra tool for cultivating his beets. However, good strong land that is capable of growing a satisfactory row of beets every 20 inches will soon pay for a beet cultivator in the extra yield, and if one expects to remain in the beet-growing business, as most growers do after trying it for two or three years, it will certainly pay to have a beet cultivator, even if the acreage each year is small.

Depth.—The depth at which beet seed should be planted is an important consideration for a good stand of beets. The quicker the leaves get through to the light and the roots strike down into the firm root bed the better the stand and the stronger the plants will be. Therefore shallow planting, $\frac{1}{2}$ to $\frac{3}{4}$ inch, is advisable provided there is moisture enough to produce germination. The seed should be placed in the moist soil at such a depth that the moisture can be kept in contact with the seed until the roots have begun to develop.

Every grower of experience realizes that soils differ considerably in their ability to hold the moisture near the surface. Climatic conditions have a marked influence on soils in this regard. In general, the depth of planting will vary from $\frac{1}{2}$ inch to $1\frac{1}{2}$ inches. Good stands are sometimes obtained with still deeper planting. In such cases, however, a slight crusting of the ground or a reduction of the temperature of the soil may retard the germination and growth of the seedlings, causing them either to fail to get through to the light or to get through in a weakened condition. It is therefore much safer to plant shallow and then use every effort to keep the moisture near enough to the surface to produce a quick and even germination.

The press wheels on the drill are important agencies in holding or bringing the moisture up to the seed, and should be set so that they will exert a firm and uniform pressure on

the drill row. In case this pressure is not sufficient to produce the desired result, we have found the smooth roller a very satisfactory tool to supplement the work of the press wheels. It is assumed, of course, that the ground is in just the right condition when the planting is done; that is, that the soil is not damp enough to stick to the press wheels and thereby be cemented together after the press wheels have passed over it. The same precaution is necessary when the roller is used, so that the ground in both cases will be left firm but mellow.

It is important also that the depth of planting be uniform. This applies to one drill shoe as compared with another and also to the same drill shoe in different parts of the same field. The depth at which one drill shoe plants as compared with another is a simple matter of adjustment, which can best be made on a level, smooth floor before the drill is taken to the field. The problem of making the same shoe plant at the same depth throughout the entire length of the row each time across the field is a question of the uniformity in the surface of the field and uniformity in the firmness of all parts of the field. If there are soft areas, so that the wheels sink in to a greater depth in some places than in others, the seed will be deposited at correspondingly varying depths. Likewise, if there are small depressions or elevations over which the wheels or drill shoes pass, the seed will be planted deeper or more shallow, as the case may be.

The result of uneven depth of planting is a lack of uniformity in the beets when they come up, a condition which is troublesome in thinning. Either the larger beets must be thinned when the smaller ones are too small, or the larger ones must be allowed to get too large.

Thinning.—At the present time practically all beet seed is planted in solid rows instead of in hills. For this reason the beets must be spaced and thinned, since they must stand one in a place at suitable distances apart in order to produce satisfactory yields. The spacing is almost universally done by means of a hand hoe of convenient size which is operated at right angles to the row, leaving the remaining beets in small tufts at suitable distances from each

other in the row. The beets that are removed by the hoe must be cut off at such a depth that they will not grow again. Numerous attempts have been made to devise a power implement that will space several rows at one time. The mechanical construction of such an implement is comparatively simple, but the fact that the beets in the row are seldom uniform in size or in stand makes the use of such a tool unsatisfactory.

It is always desirable to leave the larger and stronger plants to make the crop, and these are seldom to be found at regular and desired intervals in the row. Hence, judgment must be used in spacing the beets. Sometimes the spacing must be a little wider and sometimes a little narrower to meet these requirements, and there is no implement equal to the hoe in the hands of an interested, intelligent, and observing grower. After the spacing has been done the remaining beets should stand in tufts or bunches at intervals of from 8 to 12 inches in the row. If the soil is strong and has a good water-holding capacity, it is safe to leave the tufts a little closer than if the soil is not so strong and has less ability to hold moisture. Spacing the beets is therefore a matter of sound judgment based upon experience and a knowledge of the soil conditions.

Owing to the nature of the seed balls, composed of from 1 to 7 seeds, the seedlings stand very close together in the tufts. This necessitates thinning by hand, which is the most tedious operation in beet growing. The thinning must be carefully done, so that the beets will stand one in a place at intervals governed by the distance between the tufts when the beets were spaced. It is a well-known fact that two beets growing in contact with one another will not give as great a weight of root as a single beet would have produced at that point. This emphasizes the importance of thinning to a single beet in each place and leaving no doubles. The success of the crop depends also to a great extent upon the time at which the thinning is done, as well as upon the care that is exercised in doing it.

In general, the thinning should be done just as soon as possible after the beets get large enough to be handled,

which is usually when they have four leaves. The reason for early thinning becomes apparent when we remember that there is in the soil at a given time a given amount of available plant food and moisture, and the earlier the useless plants are removed the more food and moisture will be left for the beets that are to make the crop. The same principle holds true in regard to weeds, which should all be carefully removed from the row when thinning. As in spacing, the tufts containing the largest and strongest beets should be left; so in thinning, the largest and strongest beet in each tuft should be left to make the crop. Unless this point is carefully watched the largest beets will invariably be pulled out, as they are always the easiest to get hold of. These are minor points, but if carefully considered they will make a remarkable difference in the final yield.

After the beets are thinned they wilt for a time, leaving the bent-over stems exposed to the hot rays of the sun. For this reason the dirt should be drawn up around the plants when thinning, in order to protect them as far as possible.

Hoeing.—The beets should receive a good hoeing at the time they are thinned; that is, the dirt should be loosened up on all sides of the beet and all weeds carefully removed. The number of subsequent hoeings will depend upon local conditions. As a matter of fact the subsequent hoeings are not hoeings at all, as the work is usually performed, but consist simply in cutting out the weeds. This work is good as far as it goes, and the so-called hoeings should be repeated often enough to keep the field free from weeds. In going over the field for the first hoeing after the beets have been thinned, a close watch should be kept for doubles, and whenever more than one beet in a place is found all but the largest should be pulled out.

Cultivating.—Sugar beets should be given their first cultivation just as soon as the rows can be followed. This can be done before the spacing and thinning and again as soon as the beets straighten up after thinning. No fixed rule can be laid down for the number of cultivations that a field should receive, since this must be governed by weather conditions. In general, there should be a cultivation after

each rain, and in case of drouth the cultivations should be frequent in order to retain the moisture below.

It should be kept in mind that cultivation serves three important purposes, namely, opening the soil to admit air, enabling it to absorb and retain moisture, and to destroy weeds. Few people seem to realize that air is necessary to root growth and development, but experience has shown that air is just as essential to the activities of root growth and development as moisture. If the ground is broken up, not only will the air circulate through it, but it will absorb rain more readily, and the dirt mulch formed by cultivation will tend to hold the moisture below. The mulch is more effective if it is granular or slightly lumpy rather than of dust formation.

Weeds rob the soil of both moisture and fertility and therefore should not be allowed to exist either in or between the beet rows. The attachments or combinations of attachments to be used on the cultivator will depend upon the desired object in cultivating; that is, whether it is to break up a crust, to form a mulch, to destroy weeds, or to perform two or more of these operations at one cultivation.

The 2-row walking cultivator which has come into general use in some localities during the past few years has some decided advantages over the 4-row riding cultivator. Among other things it is more easily controlled, and consequently the damage from cultivating out the beets is greatly reduced. Few growers realize what a large percentage of their beets they sometimes lose by cultivating them out. It may be only a few each time over the field, but these often amount to considerable in the course of the season. The loss from this source is more likely to occur if the rows are crooked or the horses used have not a steady gait.

There is a wide difference of opinion in regard to the depth of cultivating, the distance that the cultivator teeth should run from the beets, and the kind of tools that should be used on the cultivator. These are all details that depend upon the condition of the soil, the size of the beets, and the object to be accomplished by cultivating. If the ground is quite foul, weeders should undoubtedly be used, but they

should be followed by deer-tongues set so that they will cut a little deeper than the weeders, in order to make a good mulch and to prevent the formation of a crust just below the mulch. If the ground has a tendency to become hard, the disks followed by deer-tongues properly adjusted will do good work while the beets are quite small. The disks should be set so that the dirt is thrown slightly away from the beets, and the deer-tongues should be set so that they will make a mulch over the entire surface of the ground between the beet rows and at the same time fill the small trench made by the disk. After the beets get larger, the deer-tongues alone are sufficient, or similar tools that will maintain a good mulch and keep the soil open so that a complete circulation of the air in the soil can be kept up.

In no case should the cultivator teeth be allowed to run deep enough to cut off the feeding roots, and care should be taken to avoid throwing dirt into the crowns of the beets.

As a rule the beet crop is laid by too early. It has been found by repeated experiments on a commercial scale that by continuing cultivation just as long as it is possible to get through the beets, even if some of the outer leaves are broken, the tonnage will be perceptibly and profitably increased without any decrease in the sugar content.

Rotation.—Every good farmer realizes that the best results are obtained with all crops when a carefully planned system of crop rotation is practised. We hear now and then of a successful one-crop farmer, but he is always the exception to the rule and it is only a question of time when some pest or some climatic condition will overtake him and show him the folly of such a course. Closely related to the one-crop farmer is the farmer who grows several crops but persists in making each crop follow itself for a long series of years. These methods are attended with a great deal of risk, not necessarily on account of the poor physical condition which often arises from their use and not so much because of the plant foods removed from the soil as from the propagation of pests of many kinds. These pests may be either insects, fungi, or bacteria.

It is well known that each particular pest develops best

and increases most rapidly on some particular crop. It sometimes happens that one or more of these pests may thrive upon several crops. For example, the fungous disease known as scab attacks both the white potato and the sugar beet. Hence, potatoes following beets or beets following potatoes may be affected by this disease even though it is the first year that this particular crop is grown in that soil.

It is important, therefore, that care should be exercised in planning a rotation system, in order that the possible evils may be avoided as far as practicable and the best results obtained. No hard-and-fast system of rotation can be advocated for any locality, but a carefully planned system should be worked out for each farm to meet its individual needs. There are some principles, however, of general application, and these should be borne in mind in planning a rotation system in which sugar beets are included.

If practicable, the crop preceding the beets should be of such a nature that it can be harvested in time to plow the ground in the fall for the coming beet crop. The crops preceding and following the beet crop should be of such a kind that they will not serve as food or host plants for the same pests that attack beets. For example, beans preceding beets and small grains following them will meet these requirements fairly well and thereby form part of a good rotation system, provided it fits in with the other farming operations and conditions. There should be one leguminous crop, such as peas, beans, clover, etc., and if the soil is deficient in humus a crop of some kind should be grown to plow under for green manure. This is especially important where the farm does not furnish sufficient stable manure to supply the soil with the requisite amount of humus. There is some danger in following a sod of any kind with beets, on account of the possible presence of wireworms, cutworms, and grubs, which often live over the winter in the sod and are ready to attack the beets the following year. It is safer, therefore, to follow sod with two other crops before planting it to beets.

Fertilizing.—The importance and the possibility of not only maintaining but improving the fertility of our soils is recognized at the present time by all intelligent farmers. There

are three classes of fertilizers that are useful in accomplishing good results, *i. e.*, stable manure, green crops plowed under, and the so-called commercial or mineral fertilizers. In the long run, no kind of soil improver can be used to the exclusion of the others if we hope to increase the fertility of our soils to the fullest extent and to reap the greatest profit from our labor. As already stated, stable manure is indispensable, but there are few farms on which enough manure is produced to maintain the soil in the best physical condition and to replace the fertilizing elements removed by the crops. For this reason in part, every rotation system should include one crop to be plowed under. Whether the primary object of the crops should be to increase the vegetable matter in the soil or in addition to this to increase the nitrogen content of the soil will depend upon conditions, and selection of the crop should be made accordingly.

If vegetable matter alone is required, such plants as rape, rye, etc., should be used; but if nitrogen also is needed, then plants like peas, beans, clover, etc., should be grown and plowed under. Vegetable matter in the soil is so essential and so liable to be deficient that the importance of constantly renewing it cannot be too strongly emphasized. Briefly, the presence of vegetable matter improves the physical condition of the soil, helps it to retain moisture, and enables the soil organisms to increase rapidly and to do their work in soil improvement. A soil deficient in vegetable matter is said to be dead, which is literally true, and our aim should be to keep it alive and well supplied with air, moisture, and available plant food. We cannot increase the actual amount of phosphoric acid and potash in the soil by the use of green manures or by crop rotations, but we can by these means do much to render these elements available for the growing plants.

When we have done all that we can do to increase the available plant food by the use of green crops and stable manure, and find that our soils are still too low in one or more of the elements necessary for the best plant growth, we should avail ourselves of the use of commercial fertilizers. These should always be used intelligently; otherwise loss instead

of gain is likely to result. For example, if we plan to use a form of fertilizer that is not readily soluble, we should apply it long enough in advance of the crop to give it time to become soluble, remembering that no mineral matter in the soil can be taken up and made use of by the plant until it is dissolved.

Harvesting.—Harvesting sugar beets consists of three distinct operations, *i. e.*, lifting, pulling, and topping. The lifting is done with either a double-pointed implement somewhat resembling a two-pointed plow, or by means of a side lifter, which is a small shoe or plow on the end of a long shank. The former is so operated that one point of the implement passes along the row on either side of the beets, raising them several inches out of the ground. The latter passes along one side of the beet row and loosens the beets without appreciably lifting them out of the ground. These implements are usually operated by means of horse power, but engines with proper attachments may be used. The kind of lifter to be used is largely a matter of personal choice. As a rule the side lifter has a lighter draft, but in either case the only precaution necessary is that all the beets be loosened and that as few of them as possible be broken.

After the beets are loosened they are thrown into piles. The number of rows of beets used in making a pile row is a matter of convenience, and it should be remembered that the larger the piles the more quickly the beets can be loaded. When the beets are pulled more or less dirt will cling to them, but as much as possible of this should be removed by shaking them or by gently striking two or more of them together when pulled. Before topping the beets, the ground where the topped beets are to be piled should be smoothed down and freed from clods, tops, etc., so that the beets can be forked on to the wagon free from all refuse.

In topping the beets they should be cut off squarely at the lowest leaf scar. This is usually done with one stroke of a heavy knife. When the beets are delivered at the factory or loading station samples are taken and if the beets have not been properly topped the sample is retopped. The percentage of weight removed by this extra topping is called

the "crown" tare, and from the sample is determined the tare for the entire load. The tare consists of two parts, *i. e.*, the crown tare and the dirt tare. The latter is the percentage of dirt that clings to the sample as compared with the weight of the roots. In actual practice in determining the tare the sample is first weighed just as it comes from the load; it is then properly topped, the dirt is removed by means of a stiff brush, and the clean sample is again weighed. The difference determines the percentage of tare.

The beets should be covered as soon as possible after they are topped, in order to prevent evaporation. The roots work much better in the mill if they are kept fresh and crisp, and they lose considerable weight if exposed to the sun and wind. If the beets are to remain in the field only a short time after topping it is usually sufficient to cover them with the tops, but if they are to remain for some days, and especially if there is danger of freezing, the piles of roots should be covered with a sufficient layer of earth to protect them.

RUTABAGA.

The rutabaga, "turnip-rooted cabbage" or "Swedish turnip," resembles kohlrabi somewhat in composition and growth, and has a dense yellow, sweet flesh. It requires about six weeks longer to mature than does the common flat turnip, which makes it difficult to produce as a spring crop, as its growing season would extend into the hot summer months. It is grown chiefly as a fall crop in northern latitudes where the cool autumn season is long, making it possible to secure large size, sweet flesh, and high flavor.

The seed are sown about July 1, usually in drills and the plants thinned. The distance between rows is 30 inches for horse cultivation, and the plants are thinned to 10 inches apart in the row. Thorough cultivation is practised and hand hoeing is sometimes required. The crop is harvested in the late fall for immediate use and storing.

KOHLRABI.

Kohlrabi has been placed along with root crops, such as radish and turnip, since its cultural requirements are quite similar. Strictly speaking, it is not a root crop, but a form of cabbage. The seed are sown in drills, in early spring,

FIG. 127.—Kohlrabi is closely related to the cabbage. The enlarged stem is the portion used for food.

from 12 to 18 inches apart. The plants are thinned to stand about 5 inches apart in the row. If an extra early crop is wanted, it may be secured by starting the plants in a hot-bed and setting them into the garden at the same time as early cabbage.

The edible portion is the swollen part of the stem just

above the ground. This growth is of highest quality when about 2 inches in diameter. If allowed to attain full size, the kohlrabi becomes tough and of poor quality.

This vegetable may also be grown as a fall crop and stored for winter use.

Salad Crops.—The term salad, when applied to vegetables, generally has reference to leaves prepared with condiments and eaten in the raw state.

The spring salad crops are: leaf lettuce, corn salad, and garden cress, of which the first mentioned is by far the most important.

LEAF LETTUCE.

Lettuce is the most universally cultivated salad crop in the United States. It is an old vegetable, having been under cultivation for many centuries. By means of forcing and field culture, lettuce in the fresh state can be had at any time of the year.

Fig. 128.—The most popular variety of leaf lettuce is the Grand Rapids variety.

Leaf, or cutting, lettuce is the form most commonly grown. The crop is easily produced, provided the weather is cool and the soil moist and rich. It is planted as an early spring or late fall crop in the home garden.

Culture.—The first sowing is made as early in the spring as the land can be fitted and succession sowings made every two weeks thereafter until the middle of May. The seed are drilled in rows 12 to 18 inches apart, and usually no thinning is done, as the leaves grow to an edible size quicker if crowding is permitted and the plants forced to reach for the light. As soon as the plants are large enough to use they are either pulled or the leaves are removed just above the crown. The latter method is desirable in the home garden, as new leaves will be produced and the bearing period of a planting considerably lengthened.

Leaf lettuce is also sown broadcast and grown in hills. The former method requires no cultivation and although inexpensive, is not to be recommended, except for the earliest plantings. The hill method is followed when large individual plants are desired. They may be transplanted for this purpose, or the seed may be sown in rows and thinning begun as soon as the lettuce is large enough to use, and continued until the plants stand 6 inches apart.

This vegetable demands an abundant supply of moisture, if rapid growth and the accompanying high quality are to be attained. Some means of irrigation is highly desirable for growing lettuce to the highest perfection. Cool weather is another requisite to high quality, as hot, dry weather causes the plant to grow slowly and become bitter, tough, and unpalatable. With proper growing conditions, which have just been enumerated, lettuce will mature in five to eight weeks, which places it in the class of most desirable vegetables for home-garden culture.

CORN SALAD.

Corn salad, or Lamb's lettuce, is quite uncommon in American gardens. It is a typical salad plant, and a native of Europe, where it is widely grown. The leaves are blanched and eaten in the green state. The seed are sown in drills 12 to 18 inches apart and covered lightly. The plants are thinned to 6 inches apart in the row. An abundance of water is required for rapid growth, which makes some form

of irrigation very desirable. The crop is grown early in spring, or sometimes in autumn and wintered over by covering with a light mulch in those sections where winters are not severe. About eight weeks are required for the plant to develop.

The portions used for food are rather tasteless, and are used for making a very mild salad.

GARDEN CRESS.

This vegetable also is not commonly grown in American gardens, although it is a popular European salad plant. The seed are sown every few days if the vegetable is wanted continuously, as germination takes place promptly and growth is rapid. Moist, rich soils are most conducive to rapid growth, and the development of crisp tender leaves. When these conditions prevail, the leaves can be grown to edible size in four weeks. This crop is grown in the spring and fall and does not thrive in hot, dry weather.

Garden cress is used for flavoring salads and garnishing, the latter use being the most important for the home grower of vegetables. The cut leaves and curled forms are preferred for this purpose.

The seed are planted in rows 10 to 18 inches distant, and the plants are thinned only as they are pulled and used. The crop is easily grown, is short-lived, and remains in an edible state for but a short time.

Spring Greens.—Greens differ from salads in that they are usually cooked and then served with condiments of various sorts. Spinach and mustard are the two vegetables grown for greens in early spring. The former is most important commercially and is the one most commonly found in American gardens.

SPINACH.

There are two types of spinach, the round-seeded and prickly-seeded sorts. The round-seeded spinach is used for spring planting, and the prickly for autumn planting, as it

is hardy and will withstand winter conditions even without protection.

The part of the plant used for greens is the succulent leaves, which are gathered when a large cluster of them has been formed.

Culture.—The type of soil best adapted to spinach culture is one that is very fertile and constantly moist. A fertilizer high in nitrogen should be applied if the soil is only moderately rich. Irrigation is of value in producing large yields.

FIG. 129.—Spinach is grown in the spring and autumn for greens. It requires a cool temperature for its best development. (The Country Gentleman.)

Spinach is a cool season crop and soon goes to seed in warm weather. Consequently, the spring-sown seed are planted as early as possible in order to mature the crop before warm weather sets in. This requires from six to eight weeks. The seed are sown in drills 10 to 18 inches apart, and may be thinned to a distance of about 5 inches in the row, although thinning is sometimes omitted. Frequent tillage is desirable to secure rapid growth.

The fall crop is sown the latter part of September, either in drills or broadcast. The plants grow almost to maturity in the fall and are cut in very early spring as they are wanted.

With this method spinach may be had several weeks before it can be harvested from spring plantings. Some prefer to mulch the crop for winter protection, although this is not absolutely necessary.

As soon as the plants are large enough, they are harvested by pulling the entire plant, or by cutting the tap root below the soil surface, and removing the plant.

MUSTARD.

Mustard is used in the same way as spinach, and is sometimes substituted for it. This vegetable is used for making both salads and greens, principally for the latter purpose. The seed are used for manufacturing the mustard of commerce.

Plantings are made in early spring for the early summer crop, in August for the autumn crop and September for the spring crop. This provides a succession throughout a large part of the year. The seed are sown in drills 12 to 18 inches apart and the plants later thinned to 6 inches apart in the row.

This vegetable is essentially a cool weather plant and soon forms seed stalks if the weather becomes warm. With proper temperature and moisture conditions, the crop develops quickly and is usable for only a short time, as the plants soon go to seed. The crop is gathered as soon as the leaves have become of sufficient size, by picking the individual leaves or by pulling the plant.

Tubers.—The vegetable of greatest economic importance in America is the tuber produced by the potato plant. The potato tuber is really an underground stem, which develops into a fleshy growth having eyes or buds on the exterior, which grow and produce new plants when the proper heat and moisture conditions are provided.

POTATO.

The potato is a short season vegetable, the early planting requiring three months and the main crop planting about four months to mature. It is a plant that demands con-

siderable moisture and does best in a cool temperature, although it will hold its own in the heat of summer. Plenty of moisture must be present in the soil at the time the tubers are "setting" if a satisfactory yield is to be secured.

Soil.—The best soil for potato growing is a deep, mellow, free-working loam. Clay loam and muck soils usually give good results, although potatoes grown on the latter are not of as good quality as those produced on sandy loams unless properly fertilized.

Tile drainage should be resorted to if the water table is less than three feet from the surface.

Potatoes grow well on recently cleared timber land, but are commonly grown after potatoes, corn, or clover sod. If the land is in sod, fall plowing is usually preferable. The depth of plowing varies with the soil; it should be 8 to 10 inches if the subsoil is not too near the surface. Sometimes spring plowing is necessary and in some cases it will be desirable to replow if the fall plowed land runs together and packs during the winter. After breaking, the spring-tooth harrow should be put on and the soil worked until in the best of tilth just before the potatoes are planted.

Fertilizing.—The necessary fertilizing elements for this crop may be secured by using commercial fertilizers, by the use of barnyard manure, or by plowing under green cover crops. The results obtained from fertilization depend largely upon the rainfall, or at least upon the amount of moisture in the soil. During seasons when the rainfall is below normal with extended periods of drouth, fertilizers will not increase the yield as materially as when there is sufficient moisture in the soil to dissolve the fertilizer elements and make them available for plant growth. A fertilizer containing nitrogen, phosphorus and potash is generally found to be more profitable than a mixture composed of one or two of the elements.

Various strengths and amounts are being used by growers on different types of soils. From 500 to 1000 pounds of commercial fertilizer per acre, testing 3 per cent. nitrogen, 10 per cent. phosphoric acid, and 6 per cent. potash, is being used with success in the middle Western States. In other sections, especially in the Eastern States, a fertilizer composed

of 3 per cent. nitrogen, 6 per cent. phosphoric acid, and 10 per cent. potash is used quite generally. The fertilizer is applied in the row at the time of planting or sown broadcast. Some potato planters are made to sow the fertilizer in the row as the seed are dropped and with this type of tool it will be more satisfactory to drill the fertilizer in the row at planting time.

FIG. 130.—A desirable type of potato having an elongated oval shape, netted skin and good quality. The eyes are a little deep at the bud end. (The Country Gentleman.)

Barnyard manure applied before growing the preceding crop will increase the humus content and thus improve the water-holding capacity of the soil in addition to increasing the fertility. Unless very thoroughly rotted, manure should never be put upon the soil the same season the potato is to be grown, as it aids in the distribution of potato scab.

Plowing down a green cover crop, such as clover or some other legume, is also a desirable way to increase the fertility of the soil.

Seed.—Successful potato growing depends largely upon the kind and quality of seed planted. The care exercised in the selection of a strain and the storage are of greater importance than the locality where the seed is grown. Northern-grown seed is planted to a considerable extent, although some growers are coming to save their own seed. If the latter method is to be followed, seed should be obtained for a start of some variety of superior qualities from a reliable grower or seed firm. These are grown in a plot by themselves and as the season advances the large, vigorous-growing plants are marked. When the digging is done, seed is saved from plants of this first selection which produce 5 or 6 good-sized tubers that are without prongs, not pointed at the ends, and that have the proper shape and characteristics for the variety.

Storing is an important factor in seed potato production. One of the best methods of keeping potatoes is to hold them in cold storage at a temperature of about 34° F. Slight freezing sometimes will do no harm if the tubers are permitted to thaw out slowly.

When it is impossible to place the potato in cold storage the home cellar or an outside pit may be used to good advantage. If it can be done, conduct air through a deep underground drain tile into the cellar to afford adequate ventilation. The length of the tile should be great enough to warm the air in winter, and the outside end of it should be covered with a fine mesh, strong wire screen, to keep out vermin. A ventilator leading from the highest point in the cellar or pit to the outside (above the roof on the cellar) will provide a means of removing the warm air. Darken the windows if there are any. A reliable thermometer should be placed in the storage room and the temperature kept uniform. If the temperature is going down too low, warm the place with an oil heater. These directions for storing apply also to the general storage of the potato crop where it is to be placed on the market late in the season.

Sprouting seed potatoes in a well-lighted room has been found by careful experiments to increase the yield and earliness and produce a more vigorous vine growth and a larger starch content. This is explained by the fact that the short, thick stem developed under the above conditions bears many scales or leaves for its height and it is from the axils of the scales that the tuber-bearing branches are produced. If the potato starts growth in the soil or a dark cellar, the scales are formed at much longer intervals which makes fewer places for the starting of tuber-bearing branches.

FIG. 131.—Sprouting seed potatoes in a well-lighted room increases the yield and earliness.

The disadvantage with this system is that the tubers must be planted by hand, because of the knocking off of the sprouts as they pass through the planter. Sprouting is desirable for the production of early potatoes, or where small areas are grown.

Cutting seed potatoes is a practice that is quite varied in different localities. The question as to the size of cuttings to

plant is largely a financial one. When seed are cheap or the variety has but a small number of eyes, the extra expense of cutting may be more expensive than the extra cost of seed. With varieties having a medium number of eyes, it is a common and reliable practice to cut the tubers into pieces having two eyes each. However, careful experiments have shown

Fig. 132.—The vitality of potato seed is impaired seriously if it is allowed to produce long, slender sprouts. (The Country Gentleman.)

that the whole potato is preferred either to the half-tuber or the two-eye pieces for total yield produced, and for the net value of the crop. Under average conditions the best time to cut seed potatoes is just before planting, and the amount necessary will vary from 10 to 15 bushels per acre, depending upon the size of the pieces planted and the distance.

Treatment for Scab.—The scab fungus will live in the soil about six years after it has once been introduced, and after it is found to be present, rotation is the only successful treat-

ment. A good remedy for the prevention of potato scab is to soak the tubers, just before cutting, for two hours in a solution of formalin—1 pound (1 pint) to 30 gallons of water.

Varieties.—Each variety of potato thrives best on certain types of soil, and with varying amounts of plant food. Some varieties, such as the Eureka, that are coarse and rough, do best on sandy loams. Early Ohio, Bovée, and Early Michigan require a rich loam soil. Carman and Early Rose will grow well under varying conditions.

In selecting a variety several things should be considered: the variety should possess good cooking quality; that is, it should not be soggy nor turn black after cooking. The flavor should be mild and free from earthiness. The variety should yield well, be able to resist disease, have a netted skin, be of a flat-round or oval shape, have few shallow eyes, and be true to name or type.

Planting.—The most suitable distance varies somewhat with the variety. They may be planted in rows 30 to 36 inches apart with the plants 12 to 18 inches apart in the row or in hills both ways. The drill system is preferable, except when the land is foul with weed seed. The depth to plant varies with the soil and season. Plant deeper on an open or light soil, especially during a dry season. About 4 inches deep will give good results under average conditions. For an early crop, plant as early in April as the ground can be properly prepared. The main crop is planted from May 20 to June 10.

Cultivation.—Thorough cultivation is very important if large yields are to be secured. On the average, from 5 to 7 cultivations have proved very satisfactory, these being given every seven to ten days until the vines cover the ground. Practice level cultivation, the same to be given with a cultivator having several small teeth and never with the double-shovel type. Plant sufficiently deep so that the soil will not need to be turned toward the vines to prevent sun burning.

Some growers have secured good yields by mulching with straw or shavings and thus doing away with cultivation. As a rule this practice has not been found profitable.

Harvesting.—Potatoes grown for the early market may be dug as soon as they have reached the desired size. Late varieties that are to be stored should not be harvested until the leaves and stems are dead, and the skins are firm and will not rub off easily. Dig potatoes when the soil is dry, pick them up at once and put them in a cool place.

The crop is generally dug by hand with a fork or with a mechanical digger drawn by horses. A satisfactory method of gathering potatoes is to place 6 to 8 bushel crates on a long narrow stone boat and pull them between the dug rows with one horse. As the boat is pulled along, two rows are picked up by a workman on each side. This does away with the heavy lifting and carrying and at the same time makes it possible to do the work rapidly.

FIG. 133.—Level and shallow cultivation gives maximum yields of potatoes.

Pest Control.—Spraying has become a necessity in the production of the potato. Insects and fungi are now attacking this crop with considerable energy and spraying has become just as important as in the growing of apples.

The most important pests attacking the potato are: the potato beetle, early blight, late blight, and the scab. Arsenate of lead is used for controlling the potato beetle; Bordeaux mixture for the blights; and the formalin treatment, previously mentioned, for the scab.

The first spraying should be given when the plants are 6 to 8 inches high and the treatment repeated at intervals of

two weeks in order to keep the plants well covered with Bordeaux throughout the season. This is necessary since Bordeaux is used as a preventative and will not cure after the blights have once entered the plant tissues. For best results, spraying should be continued as long as the plants live.

Whenever the potato beetle is present, add 3 pounds of arsenate of lead to 50 gallons of Bordeaux and apply them at the same time.

Fig. 134.—Potato leaf affected with the blight. This disease is controlled by spraying with Bordeaux.

Bulb Crops.—Onion.—The short season bulb crops are green onions which have been previously treated in Chapter XIV, with the other classes of onions.

PEA.

This vegetable is one of the few legumes grown in the home garden. It is widely planted and highly appreciated by a large majority of people. The composition of the pea is such that it is one of our most nutritious vegetables. Truckers regard it as one of their principal crops during the spring and early summer.

Fig. 135.—A pod well filled with peas of uniform size. Small peas are more desirable for canning. (The Country Gentleman.)

Peas are classified into the smooth and wrinkled varieties. The smooth-seeded sorts are hardier and can be planted earlier than the wrinkled kinds. However, the latter are

sweeter and of higher quality. Under each of these two classes are dwarf, half-dwarf, and tall varieties. The dwarf varieties are preferred for commercial planting, as they do not require support. The tall sorts produce heavier yields, must be supported, and are popular in home garden culture. The edible-podded, or sugar peas, are grown somewhat in this country, making what might be termed a third class. The pods are sometimes shelled and only the peas eaten, as is the case with our common garden peas. The plant of this vegetable is quite hardy, thrives best in cool weather, and is intolerant of high temperatures.

Culture.—The best soil for this crop is one that is cool, moist, and thoroughly drained. Sandy loams are most desirable, although any loose, friable soil will produce a crop.

The earliest planting is made in March if the land can be fitted. The smooth varieties are generally used for this planting as they are hardy. Succession sowings are made about every two weeks until the second week in May, the wrinkled sorts being used after the first or second planting. If peas are to be grown for autumn use, the dwarf varieties should be planted in August. The earliest plantings are made at a depth of 2 inches and this gradually increased as the season advances to a depth of 5 or even 6 inches. The seed are covered shallow at first, and the furrow gradually filled in as the plant grows.

In the home garden peas are planted in drills from 18 to 33 inches apart, the latter distance being common with horse cultivation. The seed are placed 1 or 2 inches apart in the row. Thinning is not practised.

Supporting the tall-growing sorts is accomplished by using brush. Another method is to plant double rows 8 inches apart and stretch poultry netting of the required height between them. Wire or cord stretched between stakes along each side of the row is also used as a means of support.

Harvesting should be done before the peas have hardened. Two to three pickings of the pods will generally remove the entire crop from the early varieties. In order to have them fresh, they are picked and shelled just before they are to be prepared for table use. Varieties that mature through a long period are best suited to the needs of the home gardener.

Peas for the Cannery.—Peas are quite commonly grown for the canning factory. It is customary to sow the seed, about three bushel per acre, with a grain drill and harvest the crop when a majority of the peas are ready, by cutting them with a mowing machine and raking them into windrows for loading. The seed is also sown broadcast and harrowed into the soil. A variety that matures uniformly is very desirable for this purpose, since the entire crop must be cut at one time.

FIG. 136.—Harvesting should be done before the peas have hardened. Large peas should be grown for home use. (The Country Gentleman.)

As soon as the crop is cut the vines are hauled directly to the canning factory and there threshed with machines which shell the peas, separate them from the pods and vines, and grade them usually into three sizes.

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Pests.—The pea louse and pea weevil commonly attack this crop.

The pea louse can be controlled successfully in the home garden by the application of a contact insecticide, such as nicotine sulphate.

The pea weevil gains entrance into the pea through the egg, the latter being deposited in the pod of the pea while in the green state. No harm is done except to the dry peas that are stored. If the seed are fumigated with carbon bisulphide, as given in Chapter X, this insect can be easily destroyed.

CHAPTER XVI.

SHORT, COOL SEASON CROPS USUALLY STARTED IN THE HOT-BED AND SET IN THE GARDEN IN EARLY SPRING.

THE vegetables that may be placed in this class are: head lettuce, cos lettuce, early cabbage, early cauliflower, and early celery. In order to mature each early in the season, the plants are started in the hot-bed and set in the garden as soon as the land can be fitted in spring.

HEAD LETTUCE.

Head lettuce differs from leaf lettuce in that the leaves fold over one another, forming a head similar to that of the cabbage, except that it is not so solid. Its chief superiority over leaf lettuce is that a large portion of the leaves are blanched, being on the interior of the head, and consequently have a more delicate flavor.

Head lettuce does not thrive at high temperatures or in a dry soil. If the plant is subjected to hot weather when young, very few heads will form. A burning of the leaf edge, or "tip burn," and the development of a bitter flavor take place if hot weather overtakes the crop after the heads have started to form.

Growing Plants.—The normal cool season of spring is too short in which to grow a crop of head lettuce by sowing seed in the open ground. Plants for early setting are obtained by planting the seed in the hot-bed about March 1, in latitudes where the first plantings are made in the garden by April 15. The various methods mentioned in Chapter VI are employed in handling the plants in the forcing structure. The use of the pot or dirt band is generally the most satisfactory. Flats are also in common use with this crop.

About two weeks before the lettuce plants are to be set in the garden the hardening-off process should be begun and continued throughout the two weeks.

Culture.—The young plants are set in a thoroughly prepared seed-bed, often as a companion crop, at a distance of 12 inches apart in the row, and the rows 12 to 18 inches apart.

FIG. 137.—Big Boston variety of head lettuce. A large portion of the leaves are blanched, giving them a more delicate flavor than that of the leaf lettuce.

Moisture being an important factor, thorough and frequent cultivations should be given this crop, and if means of irrigating are provided, water should be applied quite freely when the weather is dry. Protection from heat may be secured by cutting off a portion of the sun's rays by shading the plants with lath screens or thin cloth stretched overhead on a frame.

When head lettuce is started and grown in the garden it is handled the same as leaf lettuce, except that the plants are thinned when very small to a distance of 12 inches apart in the row.

The heads are harvested by pulling or by cutting the stem just below the head.

COS LETTUCE.

This type has "an upright habit, long loaf-shaped heads and spatulate leaves" which grow erect. The heads are tied

up if they are to be blanched. Cos lettuce will stand somewhat warmer temperatures than head lettuce. The cultural requirements of the two types are quite the same.

Cos lettuce is extensively grown in Europe, but is not well known in American gardens, although its use in the latter is on the increase.

FIG. 138.—Cos lettuce forms long loaf-shaped heads which are blanched by tying up the leaves. (The Country Gentleman.)

EARLY CABBAGE.

The types of early cabbage are the conical and round-headed shapes. The conical is the older and more common form, although early round-headed varieties are coming into common use. Only extremely early strains are satisfactory for securing an early product.

Culture.—Cabbage is a cool weather plant. Consequently it must be planted early. The young plants are started in the hot-bed, the seed being sown the first of March in pots or flats. Since early cabbage plants are easily transplanted, some prefer to grow them in the hot-bed soil, pull them loose after thorough watering, and set them in the garden where they are to grow. By shearing back the leaves trans-

piration of moisture is checked and the plant finally overcomes the shock brought about by the change. When grown in pots or dirt bands, the cabbage plant receives no shock at transplanting time, and begins growing at once in its new environment. The plants are always thoroughly hardened off before setting them in the open ground. The distance between plants is 16 to 24 inches and the rows 18 inches to 3 feet apart. Early cabbage is often grown as a companion crop with lettuce and radishes.

FIG. 139.—Charleston Wakefield cabbage is a standard early variety having a pointed head. (The Country Gentleman.)

Frequent tillage is essential to produce a good crop of cabbage. Hand hoeing is often required. The plant demands large amounts of moisture which is conserved largely by thorough cultivation.

With good culture and favorable weather, the crop should be matured in the home garden by at least July 1 and sometimes several days preceding this date. If cabbage worms attack the crop after heading has begun, they can be controlled by sprinkling air-slaked lime on the plants when they are wet.

EARLY CAULIFLOWER.

Cauliflower is closely related to the cabbage and is similar to it, except that the immature flower head is used for food instead of the head made up of blanched leaves. Cauliflower is more sensitive to its environmental surroundings than cabbage; too cold, warm, or dry weather will prevent the formation of heads. It thrives best in humid regions with cool nights and near large bodies of water. The seed is very expensive and unless good strains are secured, poor heading is quite certain to result. The amateur gardener is often disappointed in his first attempt to grow cauliflower, but with good care and a knowledge of the requirements of the plant, anyone should become proficient in producing an early supply of this vegetable for the home table.

Culture.—Cauliflower seed are sown in the hot-bed about one week earlier than early cabbage, as larger and stockier plants are wanted for setting. Otherwise the young plants are handled the same as early cabbage until set in the garden.

Setting in the garden is done about the middle of April or as soon thereafter as possible in the corn belt States. The plants should have been carefully hardened off previously, and it is preferable to set on a day that has a normal temperature for the season, so as to avoid checking the plants, which often causes unsatisfactory heading. The plants are allowed plenty of space and are set 2 feet apart in the row, and the rows from 2½ to 3 feet apart. Thorough tillage to conserve soil moisture and the application of quickly available nitrogenous fertilizers are necessary to secure rapid growth and heading before the hot, dry weather of summer.

Blanching is necessary with cauliflower to prevent the heads from sunburning and losing their flavor. Blanching is accomplished by drawing up the outer leaves of the plant over the head and tying them far enough above the head so that it can expand without rotting. This is done when the head first begins to form, and the leaves are kept in this position until the heads are ready to cut. The sun's rays are thus eliminated and the head grows to maturity in the

dark, which causes it to develop a white color and attractive appearance.

The heads develop rapidly after they have once made a good start, and they must be examined almost daily to catch them at the proper stage and cut them before they begin to break. Examinations can be made by parting the leaves on the north side of the plant so that the head can be seen.

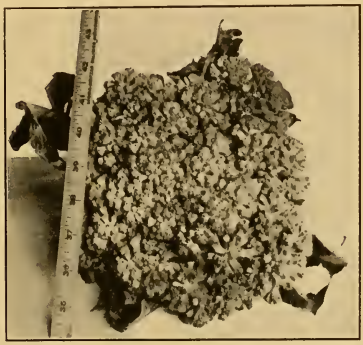

FIG. 140.—A compactly formed head of cauliflower. Blanching is accomplished by drawing up the outer leaves and tying them.

EARLY CELERY.

In order to grow celery for early use it must be well along in its development when warm weather comes on. It, too, like early cauliflower, is somewhat difficult to grow to maturity during the cool weather of spring. Celery plants for the early crop are started in the hot-bed. The seed are planted by or previous to March 1 and by shearing and shifting the plants they are made to grow stocky. The plants are set in the garden usually the last week in April and the crop harvested in August. Blanching is accomplished by the use of boards.

Since early and late celery are grown in practically the same way, with the exception of the points mentioned above, detailed cultural directions have been omitted here, and will be found in a later chapter devoted to late or main crop celery which is much more important than the early crop.

CHAPTER XVII.

SHORT COOL SEASON CROPS STARTED IN SPRING IN THE OPEN GROUND AND MATURED IN SUMMER.

Summer Greens.—Spring is the season of greens, and yet they are used also in summer. Those who are fond of greens in the latter season may have them by growing kale, collards, New Zealand spinach, chard, and dandelion. These vegetables produce new and tender growth throughout the heat of summer and even into the fall, providing a supply of this class of vegetable at a time of the year when spring greens cannot be grown.

KALE.

Kale is one of the cabbage group. It differs from cabbage in that it does not produce a head but bears rather long and narrow leaves which are curled and crinkled. The plant will stand the hot, dry weather of summer and heavy freezing weather, living through mild winters without protection. These characteristics make it a plant that can be grown the entire year for greens. For summer use only the young, tender leaves are desirable. After the plants have been severely frosted in autumn almost the entire plant may be used, as freezing is thought to improve the flavor. Consequently kale is more commonly used in late autumn and early spring when the action of frost can be obtained. It is at these times of the year that the market gardener brings it to market in large quantities.

Culture.—The seed are sown in the garden either in drills or hills and in rows $2\frac{1}{2}$ or 3 feet apart. Drilled rows which are the most common are thinned until the plants are 1 foot distant. For summer use the seed are sown in early

spring, and for fall and winter use about September 1. The latter crop is about mature by the beginning of winter and is carried over in this state and harvested from December until April.

In general the type of soil best suited to kale and the method of cultivation are the same as for cabbage. Since no head is formed, insects do not attack it as vigorously as they do the latter.

FIG. 141.—Kale is a cabbage-like plant having long, narrow, crinkled leaves.

COLLARDS.

The collard is a form of kale grown somewhat in the North, but more commonly in the South, as a substitute for cabbage, which cannot be grown there on account of the heat. The young collard and cabbage plants are very much alike. The growth of the collard is more like that of kale, differing from it in that the main stem elongates as the leaves appear, a height of 3 feet sometimes being reached.

Early in the season the entire plant is used for greens. As it grows older, only the tender growth at the top is gathered. Its culture is similar to that of kale.

NEW ZEALAND SPINACH.

This vegetable is entirely different from common spinach. It will stand high temperatures without running quickly to seed, and grows continuously through the summer and fall, forming a plant 3 feet or more in height with main branches spreading over the ground from which new growth appears continuously. The parts used for food are the clusters of succulent leaves formed at the ends of the growing laterals. These are used as a hot weather substitute for spinach.

The seed are sown in early spring in rows 3 feet apart and the plants later thinned to 1 foot in the row. Harvesting is begun in summer after the plant has reached some size and is continued until late fall.

CHARD.

Chard is also known as Swiss chard and leaf beet. It is a close relative of the common beet and similar, except that no enlarged root is formed and much larger leaf stalks and leaves are produced. The leaf stalks, which resemble celery stalks in appearance, and the leaves are the parts eaten. The blades of the leaves are prepared like spinach and the midribs and stalks are cooked and served like asparagus. Although not common on the market, and but rarely grown in home gardens, chard should be grown more generally in the home garden at least. It is easy to grow, a sure cropper, even with adverse weather conditions, and produces edible parts continuously, all of which make it a valuable garden crop.

Culture.—Chard seed are sown in early spring. The distance between rows is 18 inches; this distance being required in order to accommodate the large leaf growth. The plants are thinned to 4 and later to 8 or 10 inches in the row. The thinnings are used as greens. The oldest leaves

are always on the outside of the plant and are taken when they have reached full size. If removed carefully without injury to the crown, new stalks will continue to spring from its centre. The plant grows rapidly and several pickings may be taken during the season.

For early use the plants are started under glass in February or early March, and set in the garden as soon as the land can be fitted. If properly grown and hardened off the young plants will not be killed by severe freezing after they are set in the open.

DANDELION.

With dandelions spotting the lawn and occurring in large quantities in waste places, one might hesitate to cultivate this plant. Nevertheless it is worthy of cultivation for those that care at all for it. When planted on good soil and cultivated as are other garden crops, each plant develops a large mass of succulent leaves of such a size that only a few are required for a meal.

The plant will stand the severest winter weather and dry, hot weather in summer. Because of its power to withstand unfavorable weather conditions, it may be successfully substituted for fall spinach and kale in northern localities where these plants will not live through the winter.

Culture.—The seed are sown in early spring in rows 18 inches to 2 feet apart. One foot of space is allowed in the row for each plant. With the exception of one or possibly two shearings, the plants are permitted to develop as fully as possible, so as to store considerable amounts of plant food in the roots during the first season. Growth starts early the following spring, and rank foliage is produced very rapidly from the food stored in the roots, providing an early supply of spring greens. After the crop has been harvested in the spring the ground should be plowed or the roots removed in order to kill the plants and prevent seeding.

Summer Salad Plants.—Endive, parsley, and upland cress comprise what are termed summer salad plants. All of them are cool weather plants, but nevertheless are capable

of enduring summer heat, which the spring salad plants are unable to do. The seed are sown in early spring and the plants mature in summer.

ENDIVE.

Endive is an annual plant and is not affected by frost. The plant resembles that of the lettuce to a certain extent. The leaves are longer and are cut, curled and frilled. When allowed to grow naturally without blanching, the leaves are coarse and bitter. The crop is grown mostly for autumn use for salad purposes.

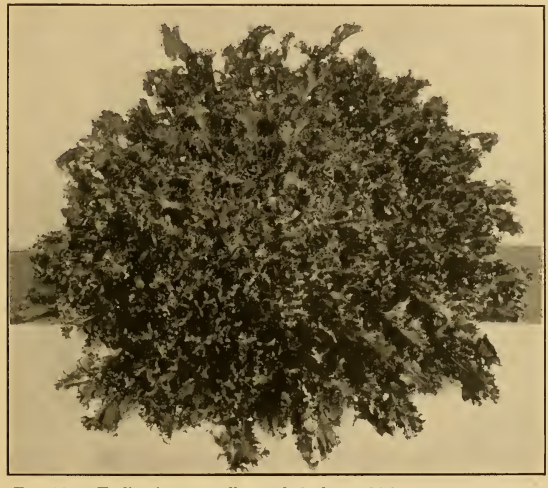

FIG. 142.—Endive is an excellent salad plant which can be grown in the heat of summer when lettuce cannot. It is blanched by tying up the heads. (The Country Gentleman.)

Culture.—For early use the seed are planted in early spring. The fall or main crop is sown in June or July,

preferably in the garden, but sometimes in a seed-bed and transplanted. The rows vary from 12 to 18 inches apart and the plants are thinned to 1 foot in the row. Applications of water, if the weather is dry, and thorough tillage should be given.

Blanching is a requisite to good quality, and is brought about by bringing the leaves together and tying them at the top so that light is excluded. This is done when the plants are dry and about three weeks before the endive is wanted, only enough being tied up at once to supply the demand from time to time, as the inner leaves soon rot after the blanching process has been completed.

PARSLEY.

Parsley is one of our most valuable plants for garnishing. In addition to this it is used to a certain extent as a flavoring medium for salads and soups. Like the other plants of this class it will thrive during the heat and dry weather of summer, and continues its growth into the cool fall weather. A winter supply can be had by digging up plants late in the fall and storing them in a cold frame, or in pots kept in the windows of the dwelling house.

Culture.—Parsley seed germinate very slowly and are sown in a hot-bed and transplanted, or sown in a thoroughly prepared seed-bed in the garden. If grown by the former method and properly hardened off, they can be set out very early in the spring, as the plants are hardy. The fall crop is planted in June in the Northern States. Radishes should be planted with parsley seed in outdoor culture to mark the rows. The rows are located 12 to 18 inches apart and the plants 5 to 10 inches apart in the row.

About three months are required for producing foliage of sufficient size to use, although very light cuttings may be made earlier. By taking only a few of the older leaves at a time from each plant, the bearing period can be greatly extended and a continuous supply secured from a small number.

UPLAND CRESS.

The leaves of cress are used in the preparation of salads and for garnishing. There are two common forms in America —water cress and upland cress. Both of these plants are closely related botanically, belonging to the mustard family. Upland cress is a native of this country, is hardy and will thrive in hot weather. It is cultivated only to a limited extent, and is used as a substitute for water cress.

Culture.—The seed are sown in drills 12 to 18 inches apart in early spring for summer use, and later for fall use. The seed are sometimes planted in late fall and after lying in the soil all winter, germinate very early the next spring. About ten weeks after sowing the crop reaches edible size. A constant supply can be had from one planting by gathering the leaves carefully so as not to injure the plant.

Beans.—String beans and green shell beans, which are short rather cool season crops, have been previously treated in Chapter XIII along with the other classes of beans.

CORN.—SWEET CORN.

Sweet corn is of American origin, and one of our most important and popular garden crops. It is termed sweet on account of the high saccharine content of the kernels when in the proper condition for eating. Sweet corn is grown in the home garden, market garden, and on a field scale for canning. On the market it is available from July 1 until frost, and can be grown to maturity in the home garden by July 15, and harvesting continued to frost by making succession sowings. The highest quality in sweet corn can be secured only when it is grown at home, so that it can be harvested, cleaned and cooked just before it is served. Corn which has been transported some distance and subjected to atmospheric conditions undergoes chemical changes which modify the quality and flavor. The plants are tender and will not stand frost.

Culture.—The culture of this crop is similar to that of common field corn. Any good corn land will produce sweet

corn. Sod land, especially clover, is most satisfactory. The grade of seed used is important, for only good quality and high yields are obtained when first-class seed are planted. It is often necessary to acclimatize sweet corn brought in from other sections. This can be accomplished by practising the home selection of seed for a period of two to five years.

The first sowing is made in the home garden as soon in May as there is no longer danger of frost. This is followed by two or three succession plantings, extending up to July 1. The early crop is planted in hills $2\frac{1}{2}$ x $2\frac{1}{2}$ feet, with three stalks to the hill. If drilled, the seed are planted so that the stalks will be 12 to 18 inches apart. The varieties planted at this season produce small stalks and ears, and are not seriously affected by cool weather. The later sowings are planted in rows 3 feet or more apart and produce larger plants and larger yields. Early plantings require seventy, and late or main crop plantings ninety to one hundred days to mature. Earliest maturity is secured by planting on light soil. Thorough and early cultivation and a rich soil are essential to good yields. Suckering should be practised also in the home garden for best results.

Transplanting can be done successfully with sweet corn if an extra early crop is wanted by starting plants in the hot-bed or greenhouse. Five or six seed each are planted in dirt bands or pots about three weeks before the corn can be set in the garden. The plants are thinned to three in each pot or band after they are up well. The roots of the corn should not be disturbed, which requires that the earth in which they are growing be handled very carefully while the transplanting is being done. They are set in the open as early as weather conditions will permit.

Sweet Corn for the Cannery.—In many localities sweet corn is grown as a general farm crop for the canning factory. The seed is furnished by the company contracting the crop and is planted with a machine dropping 4 to 6 seed per hill. The culture and general care of the crop is similar to that of field corn. Suckering is a desirable practice. When the crop is ready for harvesting the field man of the canning company

informs the grower to this effect. The ears are stripped from the stalks and taken to the factory with the shucks on. Here the shucks are removed, the corn taken from the cob and canned.

The price received for sweet corn is from $7.50 to $12 per ton, about $9 being the average. The yields vary from 3 to 7 tons, and the profits from $10 to $50 per acre.

POP CORN.[1]

There are two well-defined types of pop corn—the rice type, with sharp-beaked kernels, and the pearl type, with smooth or rounded kernels. Each of these two types may be subdivided into a number of different classes or varieties, according to color and according to size and time required to mature. The subdivision of these two types according to these characters has given some twenty-five or more varieties of pop corn.

There is no demand for the colored varieties. Some of these have excellent popping quality and good flavor, but as the popped kernels do not completely hide the colored hull they do not make as attractive an appearance as the white varieties. The less coloring matter there is in the hull or seed coat the prettier will be the snowy white mass of popped kernels. The white rice variety is grown most extensively.

Popping Quality.—The general belief now is that on the application of heat, as from a good bed of coals, the moisture in the starch cells expands with sufficient force to cause an explosion and the kernel turns completely inside out, enveloping the embryo and hull. Tests have shown that the pollination of white pop corn with pollen from yellow field corn affects the flavor, texture, and color of the popped kernels that are cross pollinated. The planting of good pure pop corn within 10 to 20 rods of field corn is likely to ruin both kinds for seed and injure the popping quality of the pop corn. The same is also true with respect to sweet corn when planted near pop corn.

To give satisfactory results in popping, corn should ripen

[1] Farmers' Bulletins 553 and 554.

fully on the standing stalk before frost comes and should then be stored where it will have sufficient ventilation, so it will not heat in curing. The kernels should be practically free from soft white matter in the endosperm and should have a moisture content of about 12 per cent. If properly stored, pop corn will retain its popping quality for a number of years. Good grades of pop corn will increase in volume from twelve to twenty times on popping.

Soil.—Any soil that is adapted to field corn will produce pop corn. The soil should be fertile and well drained. The crop prefers a soil of the sandy loam type. Avoid low muck or peat soils as they tend to retard maturity in the fall. Plowing may be done in the fall or early spring, the former being more satisfactory if the land is in sod.

Planting and Care.—Previous to planting the soil should be plowed to a good depth and the surface of the plot thoroughly pulverized. Pop corn should be planted early, so it will have a long season in which to grow and mature. A good time to plant is when the oak trees begin to show their new leaves. The rows are made about 3 feet apart and the kernels dropped 8 to 10 inches in the row. The depth of planting is 1 inch. From 2 to 4 quarts of seed are required to plant an acre.

If only a small patch is planted it is better to plant a number of short rows, as this will admit of the silks becoming better pollinated and will give better filled ears than would result from the growing of one long row. Grass and weeds should be kept down as much as possible while the corn is making its early growth, and the soil should be kept loose over the surface by frequent cultivation or hoeing.

Harvesting and Storing.—Pop corn ripens in 100 to 130 days from planting. Harvesting is done as soon as the crop is fully mature and the husks have whitened, providing the ears are not bulked, but are so placed that they will dry quickly. The best quality is obtained by allowing the ears to ripen fully and dry out as much as possible on the standing stalks. The ears may be stored in any place where the air can circulate around them freely and where they are safe from birds, mice and squirrels. Pop corn should not be stored in a

warm or heated room, as it will dry out too much. Wire crates made of fine mesh wire are convenient for storing it and afford protection against rats and mice.

New pop corn may be used for popping as soon as it has dried sufficiently. If properly stored it may be ready for use by the holidays. If old pop corn will not pop on account of having become too dry, the popping quality may be somewhat restored by moistening or sprinkling with water before popping. If very dry it should be soaked in water for a time and then spread out to dry for a few days before using, or the corn may be put in a shaded place outdoors, where it can absorb moisture from the open air. If the popping quality has been injured by freezing while yet green or immature, by harvesting before ripe, or by heating in curing, or if moths and weevils have damaged the corn, the trouble cannot be remedied by these methods.

CHAPTER XVIII.

SHORT, COOL SEASON CROPS THAT ARE STARTED IN A SEED-BED AND MAKE MOST OF THEIR GROWTH IN THE AUTUMN.

LATE cabbage, late cauliflower, Brussels sprouts, Broccoli celeriac, and late celery comprise this group. Since these crops are not set until late spring or summer, the young plants are started by sowing the seed in a thoroughly prepared seed-bed in the open ground. The principal growth of these vegetables is made in the cool weather of autumn.

LATE CABBAGE.

Late, or main crop, cabbage may be classified into the common or white, which is the most important; Savoy cabbage, which has a dark green color, and wrinkled and curled leaves; and red cabbage, which has a reddish color and is used principally for pickling. All three types demand similar cultural treatment.

1. AS A GARDEN CROP.—Late cabbage is an important vegetable in the home garden. It is grown in late summer and fall for late fall and winter use. The cultural directions for the garden crop are quite the same as given below for the field crop, the main difference being that the amount grown is smaller.

2. AS A FARM CROP.[1]—Late cabbage is adapted to general field culture on many farms where proper soils are available. Fertile muck or low-lying moist soils are well adapted to the culture of this crop.

Cabbage finds its most congenial habitat as a farm crop in the northern tier of States, including those bordering

[1] Farmers' Bulletin 433.

on the Great Lakes, the New England States, and to a less extent in Kentucky, Tennessee, and Missouri. New York grows almost three times the acreage of any other State as a farm crop. It is this farm crop of cabbage which finds its way to the sauerkraut factories, to the cities of both the North and South as the cool days of fall and early winter come on, and to the large storage houses distributed through New York and Wisconsin.

Soil.—The soil upon which cabbage is most extensively grown in this region is either rich alluvial bottom land or the rich prairies of the States west of New York and Pennsylvania. Cabbage is a bulky product and usually does not sell for a very high price per ton, but the large tonnage produced per acre and the fact that it is consumed by all classes account very largely for the extensive acreage grown throughout the area of dense population.

Preparation of the Land.—Where grown as a farm crop cabbage is used as one of the factors in a crop rotation for the farm, and may be made to occupy a portion of the clover sod turned down in the year when clover is turned under to provide for other crops. A common rotation is to use corn, followed by oats with which clover is sown. The clover is cut one season and turned under the following spring, the area being devoted to cabbage and potatoes. The clover sod is supplemented by a heavy dressing of stable manure on the portion to be devoted to cabbage. If manure is not available the necessary supply of plant food is made up by the use of a high-grade fertilizer carrying 3.5 or 4 per cent. of nitrogen, 6 or 8 per cent. of phosphoric acid, and 8 to 10 per cent. of potash, applied at the rate of 500 to 1000 pounds to the acre.

Starting the Seedlings.—When cabbage is grown as a farm crop the seed-bed is prepared in the open in a sheltered place. In the latitude of central New York seeds are sown in the open early in May. The young plants are kept free from weeds and should be ready to transplant to the field about June 20.

The choice of the site for the seed-bed may determine the success or failure of the whole enterprise. The vigor of the

plants and their freedom from disease are factors of prime importance. The seed-bed should therefore be located only on areas known to be free from clubroot and rot organisms. Areas where cabbage has been grown or where cabbage plants have been propagated in previous years are to be avoided, as are also manures containing cabbage refuse. The manure from stalls or pig sties where cabbage has been fed is to be avoided on account of its liability to carry clubroot and rot organisms.

FIG. 143.—The Copenhagen Market is a round-headed sort of recent introduction. (The Country Gentleman.)

In some localities the difficulties encountered in setting cabbage plants in warm weather are overcome by sowing the seed directly in the field. The seed drill is adjusted to drop 5 to 10 seed every 2 feet, which requires 1 pound for 3 acres when the rows are 3 feet apart. The plants are cultivated until five weeks old, and are then thinned to 2 feet. This method has been followed with complete success in some sections.

Setting the Plants in the Field.—In some localities it is customary to set the plants in check rows about 30 inches apart each way, so that they can be cultivated in both directions. In other sections the plants are set in rows one way only, and are placed 18 to 24 inches apart in the row. With the large-growing late sorts, however, 30 inches between the plants in the row is not too much space. If the transplanting is to be done by hand it will be performed by puddling the plants and setting them with a dibble. If carried on very extensively the work can, as a rule, be more economically done by utilizing one of the horse-power transplanters in which case the plants are frequently set about 20 inches apart in the row and cultivated in one direction only. Painstaking growers, however, mark the field 30 inches apart in one direction and drive the plant-setting machine at right angles to these marks, thus enabling the setters to place the plants in checkrows 30 x 36 inches apart.

This plan has the advantage of placing the plants at better intervals and permits of cultivation in both directions early in the season.

As soon as the plants have been set in the field, cultivation is started and kept up with suitable implements, depending upon the size and character of the plants, until the cultivator can no longer be run between the expanded leaves of the crop. Attention from this time on is necessary to protect the crop from insect enemies, such as the cabbage worms and the aphides or "lice."

Harvesting.—At harvest time, whether the cabbage is to be shipped, carried to the sauerkraut factory, or stored, a wagon provided with a very deep body is driven across the field, the heads of two rows having been cut and laid at one side in advance of the team. Men accompany the team and gather the heads which have been cut, carefully trim them and gently toss them to a person in the wagon, who loads them with equal care. Heads intended for long shipment or for storage should be very carefully handled, so as not to bruise or in any way injure them. In unloading to the car or storage house the same precautions in careful handling should be observed as in gathering from the field.

Pests.—Cabbage worms are often serious enemies of this crop. They are controlled early in the season by the use of Paris green or arsenate of lead. White hellebore, 3 ounces to 10 gallons of water, is preferred by many for controlling this insect, as the heads are forming.

FIG. 144.—Late cabbage is a profitable field crop on rich alluvial bottom lands or rich prairie soils.

Among the field troubles to which the cabbage is subject none is of greater economic importance than clubroot. This disease is peculiar in its method of attack and in the way in which it perpetuates itself. The chief danger with this disease arises from the fact that either the seed-bed or the field may be infected and thus contaminate the crop. There is a danger then in purchasing plants. Infected plants purchased from a clubroot seed-bed might be the means of contaminating one's cabbage land with the disease. Clubroot is a persistent malady. It will remain in the soil for five to seven years. Land so infected should not be used for cabbage, turnips, rape, mustard, or any other plant of the cabbage family. The rotation of crops to the exclusion of

all cabbage-like plants for a term of years is the only safe way of ridding the land of the disease. This applies with equal force to both seed-bed and field.

Cabbage plants should never be grown in a seed-bed from which plants showing clubroot have been taken, and a field producing cabbage with clubroot should not be replanted in cabbage for at least seven years. This indicates the importance of using every known precaution against the introduction of this disease. There is no satisfactory remedy known except the following "Don'ts":

1. Don't sow cabbage seed on soil infected with clubroot.
2. Don't plant plants grown in a clubroot-infected seed-bed.
3. Don't use manure containing roots of cabbage infected with clubroot on ground intended for the culture of cabbage or any of its close relatives.
4. Don't plant cabbage on an infected field within six or seven years after a diseased crop has been harvested.
5. Don't grow turnips, rape, mustard, or other cabbage-like plants on clubroot-infected soil unless you wish to perpetuate the disease.

Black rot and wilt are two other diseases common to cabbage. They are combated by rotation, clean seed, using clean seed-beds and practising sanitary measures. The seeds may be disinfected by soaking them for fifteen minutes in a solution of formalin at a strength of 1 pint to 30 gallons of water.

LATE CAULIFLOWER.

The culture of late cauliflower is not unlike that of late cabbage in many respects. It is more difficult to grow than cabbage on account of the cool, moist temperature that is required for its best development. The large commercial cauliflower-growing regions are eastern Long Island and other sections near large bodies of water. As a rule a sufficient supply can be grown in the home garden for family use, although during very unfavorable seasons the crop may be a failure.

Culture.—The seed are planted in a carefully prepared seed-bed, the latter treatment being desirable in order to get

a good stand, as the seed are very expensive. The distance of planting for the late varieties should be at least 3 feet apart each way so that the roots will have plenty of soil in which to forage and enough space for the proper development of the plant above ground. The blanching is done as previously given for early cauliflower.

FIG. 145.—Brussels sprouts belongs to the cabbage family. The "sprouts" or miniature cabbage heads are produced along the main stem. Their quality is superior to that of the cabbage. (The Country Gentleman.)

BRUSSELS SPROUTS.

Brussels sprouts is a cabbage-like plant differing from it in that a long central stem is produced. Leaves grow at intervals along this stem with miniature cabbage heads or "sprouts" growing in their axils. Sometimes the little heads are so close together that the stem is entirely covered to a distance

of about 2 feet above ground. The "sprouts" are from 1 to 2 inches in diameter, and are cooked and pickled in the same way as cauliflower. The flavor is like that of cabbage, except that it is of much better quality, Brussels sprouts being the highest flavored vegetable of the cabbage tribe. A long, cool, moist season is required for the best development of this vegetable.

Culture.—The seed is sown in May in seed-beds and handled the same as cabbage. A longer time is required for maturing Brussels sprouts and consequently the plants are started a few days earlier than cabbage. The plants are set 18 inches apart in the row and the rows not less than 2 feet distant. As the heads are formed in late summer and autumn at the base of the stalk, the leaves are removed, leaving a tuft of leaves at the top. The plants are quite hardy but not so much so as cabbage. Some prefer to have them slightly frozen, as it is thought to improve the quality. The crop is harvested by cutting the sprouts from the stalk. As much as a quart is sometimes harvested from an individual plant. The entire plant may also be pulled up and stored. If an early crop is to be grown the plants are started in the hot-bed the first of March and set in the garden as soon as the weather is fit.

BROCCOLI.

This vegetable resembles late cauliflower in habit of growth and cultural requirements. It demands a longer season, is more hardy to frost, and more sensitive to heat than cauliflower. In France and England it is a more important crop than cauliflower, but in our own country the climate is so unfavorable that broccoli will probably never be grown to any extent.

CELERIAC.

"Root celery" and "German celery" are common terms for designating this plant. The young seedlings have the same appearance as those of celery. When the plant begins to develop, an enlarged root is produced instead of the enlarged leaf and stalk growth common to celery. The root, which is

2 to 4 inches in diameter, is the edible portion and is used for flavoring, cooking, and for salad making, as are other root crops. The roots are stored for winter consumption, in the same way as root crops.

The culture is the same as that of celery, which follows, except that a shorter distance is needed between the rows since the crop is not blanched. The plants demand good tillage and plenty of water during their growth. Celeriac is a less exacting crop than celery.

LATE CELERY.

Every home garden should have included in it late celery to provide a supply of this vegetable for fall and winter use. At the present time a large proportion of the celery that is consumed annually is grown in certain areas that are well adapted to its culture. The region of greatest importance in celery production is that of Kalamazoo in southern Michigan. The most approved methods of growing celery, as practised in this locality, are discussed in *Michigan Experiment Station Special Bulletin No. 60*, from which the following cultural directions have been largely adapted. Although these have special reference to the growing of celery on a field scale on muck soils, they apply as well to average home garden conditions.

Soil Types.—The celery of Michigan is grown entirely on the heavy reclaimed muck lands that have been previously well drained. These soils are generally very deep, often extending from 20 to 30 feet before reaching the subsoil, which is generally of a hard, stiff clay. Three or 4 feet of good top soil, however, is generally considered sufficient upon which to grow good celery, provided it is well drained and is a good, strong muck soil. A shallow muck with a quicksand subsoil is not preferred and the spring muck lands, common in some sections, are also unfavorable. Black ash or elm muck lands are considered the strongest and best for celery production.

Celery may be grown on any good garden soil that has been previously well enriched with stable manure or organic

matter, but for commercial growing, the muck lands are to be preferred in this state. They are fertile soils, contain much decomposing vegetable matter, and with water but a few feet from the surface, a constant supply of moisture is assured. These requisites, namely, a fertile soil well filled with organic matter and a constant supply of moisture from below are of most importance, as the celery plant cannot be stunted at any time during its growth if good quality is desired. Heavy clays are not good celery soils, as they lack

FIG. 146.—In the home garden celery should be grown for high quality. (The Country Gentleman.)

the desirable physical characteristics. This crop requires a soil of loose texture that does not pack hard around the plants. On clay soils there is also apt to be considerable trouble caused by the washing of the soil over the hearts of the plants while they are small. Muck lands contain the ideal physical characteristics of a celery soil.

Fitting the Soil.—In preparing new lands for celery it is a general practice to grow corn, potatoes, or some other cultivated crop the first year on the soil, to put it in as fine tilth and get it as free from weeds as possible. Summer fallowing and fall plowing are also advantageous in preparing these new lands for celery and should be practised when it is not advisable to cultivate two crops a year before planting. If the land has been cropped for a number of years, it will be advisable to build up the soil before attempting

to grow celery. Such lands are especially apt to be of a poor texture and heavy applications of stable manure should be applied to some other cultivated crop for a year or two before planting celery. If stable manure is not available, a crop of clover or other cover crop may be grown and turned under to supply the nitrogen and humus which these soils require.

When the land is grown successively each year to celery the soil is plowed as early in the spring as possible after it is dry enough to work. Larger plows are generally used than on the uplands and the soil should be plowed deeper, 10 inches being none too much. On most of the muck lands the soil will be found too soft for disking and therefore the spring-tooth, Acme or smoothing harrow must be relied upon for preparing it. The plank drag or float is commonly used to smooth off the land, break up the clods and pulverize the soil. The land should be alternately harrowed and dragged until it is brought down to a very fine condition. After it is thus prepared, the soil should be harrowed again after every rain or at least about once a week until planting time.

Fertilizing.—Celery is a rapid-growing crop and requires heavy feeding to produce a continuous and healthy growth. Even on the rich muck lands it requires heavy fertilization if continuous crops of celery are to be grown. Celery, too, requires a soil of loose texture well filled with organic matter. For these reasons stable manure is universally considered the best fertilizer, as it fills these requirements most satisfactorily. The amount that can be applied at a profit depends upon the intensiveness under which the crop is grown, the general condition and fertility of the land, and the cost of manure per ton laid on the land. From 30 to 40 tons per acre is considered advisable each year on the Kalamazoo lands, where the same soil is used continuously and where two or three crops are harvested each season. In these sections, being convenient to the city, little difficulty is experienced in obtaining a sufficient supply at a reasonable price. Whether or not outlying districts, where land is cheaper and the cost of manure higher, can afford to fertilize

as heavily and produce as intensively, is a local problem. Where but one crop of celery is grown, about 25 tons per acre is sufficient on good muck lands. Many of the outlying celery districts and some of the Kalamazoo growers obtain their supply of manure from the Chicago stockyards. This costs about $25 to $35 a carload of 30 tons laid down in town, depending much upon its distance from Chicago. Uncertainty as to the quality of the manure and the time it will be received after it has been ordered from Chicago has tended to discourage its use among the growers.

There seems to be a strong preference in the Kalamazoo district for horse manure over the other kinds, and if it contains much coarse straw, it is the practice to shake it out and apply only the fine manure. It is stacked in large flat piles about 3 or 4 feet high, if obtained during the growing season, and spread over the land any time in the spring before plowing. On heavy, compact muck land coarse hay or straw is often turned under to make it mellow.

Commercial fertilizer used alone does not make it possible to grow celery on the same land year after year. We do not advise its use, therefore, as a substitute for stable manure, but we do believe that an intelligent supplementing of manure with commercial fertilizers would result in as good crops at a less cost. Muck lands are rich in nitrogen and contain, generally, a sufficient supply of phosphoric acid, but are lacking in potash. Although no definite data are available, no difference has been detected, after making careful observations, in the crops of growers where muriate of potash has been applied with 20 to 25 loads of manure per acre, instead of 40 to 50 loads. It is probable, therefore, that the growers of celery on muck lands could greatly economize on the cost of fertilizers by reducing the amount of stable manure applied every second or third year and supplementing it with about 300 pounds of muriate of potash.

Nitrate of soda is a very soluble form of nitrogen and acts very quickly upon the plants. A week or two after the plants have been set in the field and have taken hold, it is a very common practice to spread a dressing of 150 to 250 pounds of nitrate of soda over the soil to stimulate the plants into pro-

ducing a very early crop. The nitrate of soda is scattered along the side of the rows on top of the soil, being very careful not to let it come in contact with the plants, and it is then cultivated into the soil. It is preferable to do this while the foliage is dry to prevent the burning of the leaves. The effect of this fertilizer lasts only for a short time, after which another application is often desirable. In producing mid-season or winter celery, nitrate of soda is not essential unless the crop becomes stunted and something is needed to stimulate the plants. As this form of nitrogen is very soluble, it is more satisfactory to apply two or three light applications at intervals of a couple of weeks than one heavy application.

Growing Plants.—It is of vital importance in growing celery to be certain of obtaining first-class seed. Many of the failures are directly caused by poor seed which either fails to germinate or produces plants lacking in vitality and uniformity and very subject to diseases. Good seed must not only be true to name and germinate a large percentage of seed, but the seedlings produced should be strong and vigorous, giving the plants a good start. Most of the best seed of the self-blanching varieties is grown abroad and known in the markets as imported French seed, while California produces excellent seed of the green varieties. Celery seed, therefore, should be purchased only from the most reliable seed dealers.

Celery seed loses its vitality, under ordinary conditions, very quickly, and hence fresh seed should be procured each year. Some growers, however, are successful in retaining it for a season when they secure seed of excellent quality. Although this is not to be recommended as a practice, there are times when it is often advisable to do so. To store seed successfully it should be kept in a sealed Mason jar and placed where the temperature is moderate and uniform.

For an early crop of celery the seed is sown about the last week in February or the first week of March. It is the aim to sow early enough to have plants of proper size ready to plant in the fields as soon as the weather conditions of the spring permit. If the seed is sown too early, the growth will be checked in the seed-bed and the plants, when set in the field, will be stunted and liable to run to seed. In most of the

celery sections of this State, greenhouses are erected for starting the crop. At Kalamazoo a small greenhouse covered with removable sash and heated by a small stove is generally used, while at Muskegon a larger and more up-to-date greenhouse is built with a permanent glass roof and heated by one or more stoves. These are practicable, cheap structures and economical where celery is the only crop grown in the greenhouse. Hot-beds may sometimes be used where the greenhouse is not available, but the conditions of moisture and temperature cannot be controlled as uniformly, and in many other ways it will be found less satisfactory for starting the earliest crop.

The soil of the seed-bed should consist of a rich garden soil that contains an abundance of plant food and that will not pack and harden. In this State muck soil is generally used and found very satisfactory. As the celery seed is very small and also very slow to germinate, the soil should be made very fine and smooth before sowing. It is the usual practice to sow the seed broadcast, rather than in rows, although the latter method has the advantage of permitting room between the rows to cultivate and water. The seed should be covered not over one-eighth of an inch with soil and sowed sufficiently thick to give a good stand of plants without crowding. If the seed is good, about 60 per cent. of it should germinate under favorable conditions. One ounce of seed should produce at least ten thousand plants.

After sowing the seed-bed may be rolled or carefully raked by hand. Many growers prefer to scatter the seed and allow the rains to wash it into the soil. With indoor sowing, burlap is often spread over the soil and the beds sprinkled. A large percentage of culls or small plants at harvesting time is largely due to one or a combination of two things, namely, the use of poor seed or the crowding of the plants in the seed-bed. Therefore care should be exercised at this time to be certain of obtaining the best seed and in not sowing the same too thick in the seed-bed.

The seed for the second crop is sown about the last week in March and usually started in hot-beds. If space is available, the seed may be started in a greenhouse.

Celery that is to be harvested after September 1 is generally sown in outdoor seed-beds, planting the seed as early as weather conditions will permit. The soil of these seed-beds should be well fertilized with fine, decomposed stable manure and fall plowed. The beds may be slightly raised above the walks and of a width to permit convenient reaching of all plants without tramping on the beds.

The soil of the seed-beds should be watered after sowing whenever the surface soil appears dry, but care should be exercised to prevent overwatering. After the plants are up they should be kept constantly growing, and watered only in the morning of bright days that the foliage may become thoroughly dried before night. If the plants in the seed-bed appear too thick, they should be thinned as soon as possible by removing the weakest plants in such a way as to leave the others well spaced. The temperature of the seed-beds in the greenhouse should be kept at about 75° during bright days and about 10° lower at night. During dark, cloudy weather, it is advisable to keep the temperature somewhat lower. Ventilation should be given whenever the weather conditions permit and the plants hardened off gradually by increasing the ventilation until out-of-door temperatures may be favorably endured before transplanting to the field.

Transplanting.—Celery plants are not usually transplanted before setting in the field. The advantages under existing conditions do not seem to warrant the extra labor and expense involved except when a very early crop is desired or an extra fine grade wanted for a special market, in which case it may prove a profitable practice. Transplanting induces the formation of a well-branched, fibrous root system, causing a less serious check to their growth when finally planted in the field. This results in a crop a little earlier and generally more uniform. When practised the seedlings are transplanted into small pots, shallow boxes or into beds, placing the plants about two inches apart. The seedlings are ready for this transplanting about four weeks after seeding.

Setting.—The ideal time to set the plants is just before a shower or on a moist, cloudy day. In bright weather it is preferable to set late in the afternoon. On large farms it is

necessary to set during all kinds of weather and at all times of the day in order to get all the plants into the ground in season. Extra care, therefore, must be exercised to gain a good stand of plants during bright, dry weather. The seed-bed should be well watered a few hours before digging and the plants carefully lifted to retain a large root system.

When only a small acreage is to be planted, they may be dug carefully with much of the soil clinging to the roots, but a commercial grower can hardly afford to practice such care. The plants are usually packed in shallow pans or buckets and dropped in the field from these receptacles. The rows may be marked off with a line or marker if desired, but since it is advisable to always plant in freshly stirred soil, most growers prefer to mark off but a short space at a time before planting and hence prefer the "shoe method." This operation consists in scuffing out a shallow furrow in the soil with one foot as a person walks up the row. Just before setting the plants in the row the soil is wet down with water applied by hand from a large sprinkling can. If but one watering is given at this time, it is considered better to water before rather than after setting the plants, although it is most desirable, in dry weather, to water both before and after setting. The plant is then set with its crown slightly below the top of the ground and the soil pressed firmly around the root. On clay soils greater care must be exercised not to set the plants too deep, but on muck lands and sandy soils there is not so much danger of the soil injuring the hearts of the plants.

Distance.—The distance to plant celery depends upon the variety, season, methods of blanching, and intensiveness practised. Where celery is to be blanched by boards, the rows may be set from 18 inches to 3 feet apart, while celery which is to be blanched with soil is commonly set from 4 to 6 feet apart. Where early celery is grown, the first planting is set in rows about 3 feet apart and the second crop is planted later between these rows. Sometimes only every alternate row is thus interplanted at first, but a late crop is afterward set in the vacant places. This will leave a space of 6 feet for blanching the last crop with soil. When a summer crop is grown alone and the celery is to be blanched

with boards, the rows are set from 18 inches to 2 feet apart. In other sections, where land is less valuable and the culture less intensive, the rows are planted from 3 to 4 feet apart, thus permitting horse cultivation. In outlying sections, where larger areas are handled, the cost of production will be less if planted at about this distance.

The distance the plants are set in the row is also more or less variable, but 3 plants to a foot is the general rule in this State. Giant Pascal and other large-growing varieties are usually set 6 inches apart, while some growers even prefer a space of 8 inches for this variety.

With the rows 3 feet apart and the plants 4 inches apart, 43,560 plants and 29,000 square feet of lumber are necessary for planting and blanching one acre.

Cultivation.—Celery must be kept continuously growing if stalks of high quality are desired. Although an excessive feeder, demanding plenty of plant food and moisture, the plant has a very shallow root system. Therefore constant but shallow cultivation is absolutely required to produce good crops. As soon as the plants are set in the fields the rows should be cultivated, especial care being taken not to throw any soil over the hearts of the plants. Hand hoeing may be necessary between the plants. Cultivation must be given then after every rain and as often otherwise as it is necessary to maintain a fine dust mulch over the soil. This will prevent the moisture of the soil from passing off into the air, and in addition to keeping the roots well supplied with water, it will prevent the roots from working deeper into the soil where the supply of air is not so plentiful and the production of plant food not so rapid. Constant cultivation induces a larger and better quality of growth by preserving the soil moisture and keeping the roots near the surface where the plant food is liberated more rapidly.

As the surface of the soil in cultivating should not be thrown up in ridges but kept as smooth and fine as possible, a small-toothed cultivator should be used in preference to the larger shovel-tooth types.

About the Kalamazoo section the crop is planted in rows too close to permit horse cultivation and the fields are worked

with hand cultivators. These are especially desirable for cultivating the crop, as they permit stirring the soil very close to the plant without danger of injury by deep cultivation.

FIG. 147.—The main crop of celery is usually blanched by working the soil up around the plants so as to exclude the light.

Blanching.—The blanching of celery consists in excluding the light from the leaf stalks while the plant continues its growth, which causes the destruction of the coloring matter, leaving the stalks very light colored with a mild flavor and a more crisp and tender texture.

There are many methods that may be used to accomplish this purpose, but on a commercial scale, the only ones of importance practised in this State are blanching by boards and

by banking with soil. Formerly most of the celery was blanched by the latter method, but today the method employed depends largely upon the time of the year the crop is used. When a crop is to be blanched during the summer months, one of the self-blanching varieties is grown and the plants blanched by the use of the boards, for if the soil method is used at this time, it causes the plants to rust. When celery is to be blanched during the cool weather of the fall, however, it is blanched by banking with soil which produces celery of an

Fig. 148.—Celery is grown extensively on drained muck land. The early crop is blanched with boards. (The Country Gentleman.)

excellent flavor and protects the plants from light frosts. When the crop is to be stored for winter use it will blanch in storage if the temperature is not too low and will keep better if not blanched too much in the field.

Boards for blanching are selected from sound hemlock 1 inch thick, 12 inches wide, and 12, 14 or 16 feet long, although at times boards 10 inches wide are used to blanch the earliest crop when the plants are not large. If small cleats are nailed across the ends and middles of the boards it will tend to prevent splitting and warping.

In placing the boards for blanching, they are first laid flat along both sides of the row; then two men working together at each end of the board raise the edge nearest the plants, catching up the outside leaves, until the board is brought into a vertical position along the row; then, holding it in place with one hand, the board on the opposite side of the row is likewise brought into position, leaving as little space between the boards as the thickness of the plants require. Double hooks about 6 or 8 inches long, made of heavy galvanized wire are then used to hold the upper edges of the boards together. Sometimes short pieces of laths are nailed across the tops to hold them in position, but this method is not convenient for the extensive grower. After the boards are in position a little soil should be thrown along the lower edges to close any openings that may be caused by the unevenness of the surface of the soil.

From two to three weeks will be required for blanching the summer crops, depending much upon the rate of growth and weather conditions. As soon as the crop is properly blanched it should be harvested, because when left too long it loses in weight and flavor.

After the day's harvesting and packing is finished, the boards are carried to another patch of celery and used to blanch another crop. In this way they are used several times in a single season.

Soil is generally used for blanching fall and winter celery. This method produces crops of the highest flavor and for the extensive grower is the most economical. The banking of celery is generally done by the use of a plow or celery "hiller" which throws the soil up in ridges against the plants. To prevent the soil from covering the hearts of the plants the rows are first cultivated and then a small amount of soil is banked against the base of the plants by hand to straighten up the stalks and hold them together. This practice, which is called "handling," leaves the plants ready to be banked by the plow or "hiller" and as the crop continues its growth the "hiller" is used to keep the soil thrown up about the plants.

The new celery culture is a method of growing celery which makes it unnecessary to use artificial materials for

blanching. The plants are set in beds from 10 to 12 feet wide with the plants 6 inches apart in rows and the rows 8 to 10 inches apart. When the plants have become so large that they cannot be cultivated, boards are placed on edge around the bed to exclude the light from the outside rows and blanch them, those on the interior being blanched since they are so close together that all light is kept out by the foliage.

This method is to be recommended for home garden culture where the soil is very rich and a constant supply of moisture can be provided. The early varieties can be thoroughly blanched in this manner without the use of boards for every row.

Harvesting.—Celery may be harvested as soon as it attains the proper size and is well blanched. With the earliest crop it is frequently cut slightly before this time, and it often pays better under these circumstances than to wait for the crop to fully blanch and mature. If the plants are left too long after they have matured, they lose their crispness and flavor and are apt to become diseased.

When the crop is harvested during the summer months the plants should be cut early in the morning. In the Kalamazoo district this work is all performed before 7 o'clock in the morning. The boards used for blanching are removed only as fast as necessary and laid between the rows to serve as a walk. If the plants are left exposed to the sun and wind, they lose their firmness and are apt to wilt, hence the boards are removed only as fast as the celery is cut. Using a stiff knife or spading shovel, the roots are cut a short distance below the surface of the soil and the plants laid in small piles along the boards.

Pests.—Late celery blight is the most serious disease attacking this crop. It first appears in late summer or early fall as irregular rusty brown spots on the outside leaves, spreading under favorable conditions over the entire leaf surface and to other leaves of the plants, causing a burned appearance to the foliage in a very short time. The disease may be prevented by spraying the plants with Bordeaux mixture, using the 5-5-50 formula, or the ammoniacal carbonate of copper spray, beginning when the plants are small,

spraying once before lifting them from the seed-beds, and continuing the spraying every ten days or two weeks until the plants are ready to blanch by boards. The success of this work will depend largely upon the thoroughness with which the foliage of the plants is covered, as it is important that all portions of the plant be reached by this spray. All diseased plants and refuse left in the field after harvesting should be carried from the land, rather than to turn it under with its spores of this disease to cause another infection the following season. Where conditions will permit, rotation of crops will prove very desirable, devoting the land to cabbages, onions, peppermint, or some other suitable crop for two or more years until the land is free of these spores.

The parsley and zebra caterpillars are controlled by hand picking. Sanitary measures should be followed each season.

CHAPTER XIX.

VEGETABLE STORAGE.

THE first and most important office of the home garden is to provide a continuous and adequate supply of fresh vegetables throughout the growing season. A garden that is so managed as to do this is a success both financially and otherwise. There are, nevertheless, many gardeners who are not content with growing a fresh supply, but also desire to produce enough more to make it possible to provide a store of them to last a part of, or perhaps throughout, the winter months. This is to be commended, since it will reduce to quite an extent the cost of food during this portion of the year when living expenses are above the average.

Vegetables may be held for winter use by:

1. Storing them in a temperature that is above freezing and yet so low that sprouting or rotting does not occur.
2. Canning.

STORAGE.

Various practices are in vogue in different sections of the country for storing vegetables. This is due largely to the fact that the conveniences for storing are meagre and mostly temporary.

Requirements for Successful Storage.—Proper moisture, temperature, and ventilation for the storage room and proper maturity of the vegetables are requisites for successful storage.

Moisture.—Moisture in proper amounts in the storage room aids in prolonging the life of vegetables thus handled. Root crops and cabbage keep best in a fairly moist atmosphere. Onions, sweet potato, squash, and pumpkin require a dry atmosphere. It is impossible to store these two groups

of vegetables in the sanie room with good results, yet they all are often put away together in a damp, or perhaps a very dry cellar for winter use.

Temperatures.—Temperatures for storing vegetables are all relatively low (the best is a few degrees above freezing) with a few exceptions. The sweet potato, pumpkin, and squash keep longest in specially constructed rooms in which the temperature is kept high by artificial heat, if there is need for it. Not only the right, but also a uniform, temperature must be maintained. Fluctuations in temperature, especially of several degrees in short periods, soon cause vegetables to deteriorate. In order to be able to control the temperature the storage room must be so constructed and arranged that outside temperatures can have little or no influence upon it. This is a matter of construction that will be considered later.

Ventilation.—Ventilation is an important consideration in the successful storage of vegetables. If the air is taken from the outside in cold weather, some means of warming it should be provided before it enters the storage room. This may be accomplished to a certain extent by drawing the air through an underground flue. Circulation of air in the storage is aided by the construction of slatted bins or crates and by leaving space between the bins or crates and the side walls. Flues or vents are installed to permit the entrance and escape of air from the storage room. The movement of fresh air carries away the odors given off by the vegetables, thus keeping them fresh, and helps to check the development and spread of storage rots.

Maturity.—Maturity, or the degree of ripeness for best results in storage, varies with different vegetables. If to be stored, vegetables should be planted at such a time that they will reach the proper stage of ripeness when they are to be placed in storage. This may require special plantings rather late, since the storage season is delayed until as late as possible, and still have it begin before there has been injury from freezing. Root crops become tough and pithy if planted so early that they must be left in the soil several weeks after they are mature before storing. Cabbage heads

will burst before the weather is cool enough to store them if they are planted too early.

The long season vegetables, such as onion, parsnip, salsify, horseradish, and leeks, are planted as early in the season as the land can be fitted, in order that their growth will be completed in time to store them before freezing weather. Late varieties of carrots and beets are planted in early May for winter storage. Transplanted cabbage, Brussels sprouts, and celery will mature late if planted July 1 to 15. Turnips, kohlrabi, and winter radishes are the latest to be planted, the date being about August 1, when they are grown to store for winter consumption.

Methods of Storing.—The whole subject of vegetable storage has secured little attention up to the present time from an experimental stand-point. The accommodations for vegetable storage today are almost entirely the same crude ones used by our grandfathers. Consequently, it will only be possible to consider those methods, which, although crude, have given fairly satisfactory results when used on a small scale for the storage of a home supply of vegetables for winter.

There are a few important considerations to have in mind when constructing a satisfactory storage. The first one is that of protection against frost. This is not difficult to accomplish when pits or underground cellars are used. Rooms entirely above ground should have tight walls with dead air spaces to keep out the cold. Artificial heat may also be required at times during very severe weather to prevent freezing. The second consideration is that of constructing so that the desired moisture conditions are obtained. This is generally accomplished by using rooms entirely above ground where a dry atmosphere is wanted, as for onions, and an underground cellar or pit for such as the root crops that demand a moist atmosphere. Another consideration is that of ventilation which can be provided by the construction of flues or vents.

The Underground Pit.—The underground pit is the simplest and oldest method of storing vegetables. The most important consideration in its use is the location.

This should be such that ample drainage is provided at all times, which is accomplished by placing the pit on an elevated site and in a loose soil, if possible, so that water from rains and melting snow will not collect in the pit and be retained there. Where the drainage is good, a pit 2 feet in depth, about 3 feet wide, and of sufficient length to contain the vegetables, is dug. The pit is then lined with boards, straw, or sometimes is left unlined, the vegetables being placed in direct contact with the soil. The vegetables, such as root crops and potatoes, are then placed in the pit heaped so that they are considerably above the soil level in the center and sloping gradually toward the edges to such an extent that the roots are on a level with the soil surface at the edges of the pit. After the roots have been placed as just indicated a layer of straw is usually placed over them and the pit is allowed to sweat and heat. After this period is past and the weather grows colder, earth is gradually added of sufficient depth to keep the vegetables from freezing. If some of the straw is allowed to protrude through the soil that is placed on the pit, it will serve as a means of ventilation. Otherwise it is sometimes advisable to put a small wooden vent in the center of the pit down through the soil to provide adequate ventilation. A foot or more of soil on the pit is required for proper protection during the coldest weather. In addition to the soil and straw it may be desirable to place bundles of corn fodder over the pit for further protection.

It is also a common practice to store vegetables as just given, except that no pit is dug, the vegetables being placed on top of the ground and covered. This is desirable when soil drainage is inadequate.

The Outdoor or Sod Cellar.—The outdoor or sod cellar is in common use in many sections of the country. It usually consists of a pit covered with an even span roof of sod supported underneath by two by fours or poles cut of the proper length. The entrance way or door is generally placed at the south or east end on the side opposite from the prevailing cold winds. This type of storage is cheap, easy to construct, and frost-proof. It is adapted to the storage of

root crops and cabbage. The disadvantages with it are that it is not permanent, and is somewhat inconvenient.

Where the land is rolling, side hill cellars are easily constructed, and, being so nearly surrounded by soil, the temperature remains very constant. Cement is often used in constructing this type of storage, which makes it permanent.

FIG. 149.—A side hill storage constructed of concrete: Being located on a northern slope and surrounded on nearly all sides with earth the temperature remains cool and constant.

House Cellars.—House cellars are in common use for storing vegetables. Their advantages are that they are very convenient, are frost-proof, and permanent. On the other hand, the temperature and moisture conditions are not right, if there is a furnace and wash room in the cellar. The atmosphere is generally too dry and the temperature too high. These unsatisfactory conditions may be overcome to a certain extent by having a storage room built into the cellar with arrangements for outside ventilation to keep it cool. The odors given off from cabbage and vegetables in the house cellar are unhealthful. Special means for ventilating the storage room in the cellar should be provided to prevent the disagreeable odors from passing to the living rooms of the dwelling.

Cold Storages.—Cold storages are used successfully for storing vegetables in quantity for market, but are impracticable for the use of the home gardener.

FIG. 150.—An underground cellar constructed of concrete. The flue at the top provides for ventilation which is required for the successful storage of vegetables. (The Country Gentleman.)

Storage for each Vegetable.—As previously mentioned, some vegetables require different storage conditions than others. General directions for storing vegetables follow herewith.

Cabbage.—Cabbage for early winter use is stored in the cellar by packing it away in sand in barrels, if likely to wilt. For late winter use it is preferable to place it in an outdoor pit. The pits are usually made entirely above ground. The cabbage heads are pulled with the roots and leaves attached and placed upside down in the pit.

Parsnips, Salsify, and Horseradish may be left over winter in the ground where they grew, as freezing does not injure them. It is more convenient, however, to dig and place them in piles on the ground and cover them with 5 or 6 inches of soil. This makes it easy to dig them in winter when the ground is frozen. These vegetables may also be packed away in moist sand and stored in a cool cellar or pit.

Turnips, Carrots, Beets, Irish Potatoes, and Rutabagas are stored successfully in an underground pit or the sod cellar.

Brussels Sprouts, Parsley, and Leeks may be stored for winter use by digging them with the roots on and planting them close together in a cold frame before freezing weather. Straw, mats, or some other material of a protective nature, should be placed over the cold frame in the coldest winter weather. Parsley is also wintered over by setting a few plants in pots and keeping them in the living room, as are common house plants.

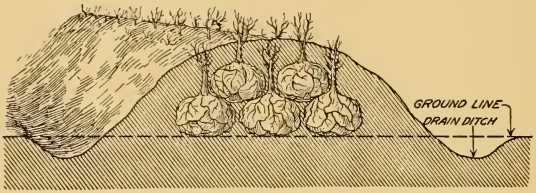

Fig. 151.—A convenient and satisfactory method of storing cabbage for late winter use.

Celery.—Celery for home use is dug with the roots on and planted in moist earth in the cellar floor, or planted in boxes and placed in the cellar. The cellar should be kept dark, cool, and well ventilated, and the soil about the roots should be kept moist. When handled in this way the celery plants grow very slowly and, if light is excluded, they are thoroughly blanched and of very high quality.

Sweet Potatoes, Squash, and Pumpkin should be stored in a warm, dry atmosphere. The first mentioned keeps well when placed in open crates in an upper room adjacent to the chimney where the night temperature is warm as well as that of the day. The furnace room provides another good place for storing sweet potatoes, and also squash and pumpkin,

Onion Storage.—Onion storage begins with the curing, which must be done in a thorough manner immediately after harvesting, if they are to keep well. Low temperatures are desirable after the curing process has been completed. If the temperature of the house cellar is kept low, onions may be stored therein quite successfully, if placed near the ceiling and frequent ventilations given. Dairy products and onions do not thrive well in the same room, however, and should be stored in entirely separate rooms.

FIG. 152.—A simple and inexpensive steam-pressure outfit for canning fruits and vegetables. (The Country Gentleman.)

CANNING.

Many vegetables, which cannot be held successfully in storage, are canned for use in winter. In the past the difficulties encountered in canning vegetables in the home were so great that the work was left principally to the large

canneries. Improved methods and small-sized canning outfits built upon the principle of the larger ones, make it easy for the home grower of vegetables to can the surplus during the season.

There are two kinds of canning outfits on the market made in convenient sizes for handling small amounts of vegetables at a time. One of these outfits is operated by the use of steam under pressure and the other by using hot water.

FIG. 153.—A hot-water canning outfit composed of common kitchen utensils. Many garden vegetables can and should be preserved for winter use. (The Country Gentleman.)

Just which one is the better is an open question, and depends largely upon the personal preferences of the operator. Both will do satisfactory work. Either glass or tin cans are used as containers, the former being about three times more costly, but may be used several seasons.

Some of the vegetables that are commonly canned are: tomato, sweet corn, peas, string beans, and asparagus. None of these can be held in common storage.

CHAPTER XX.

LABORATORY EXERCISES IN GARDENING.

One of the most valuable lines of practical laboratory work in agriculture is that of school gardening. Its strength is in its completeness. The student is able to test the seed, prepare and fertilize the land, plant the crops, cultivate and harvest them all in one season, since only a short period is required to mature most vegetable crops from seed.

The first requisite for conducting practical school garden work is land and equipment.

Location.—Land for garden purposes should be located as conveniently as possible to the general meeting place of the class and near a greenhouse range if such is available. The service building of the greenhouse provides an ideal place for storing tools and seed and for handling transplanted plants.

In rural high schools it has been found advisable in some cases to have the garden located at the home of the student. The plan and seed order are prepared under the direction of the person in charge of the course as a part of the laboratory work. The transplanted plants are started in hot-beds on the school grounds and taken to the home garden and set at the proper time. A model garden conducted at the school grounds will serve as a guide in planting and handling the garden at the home of the student. With this arrangement the garden can be cared for during the summer after school has closed, and the vegetables are also available for table use. The instructor in charge can inspect and grade each garden at intervals throughout the season.

The type of soil, exposure, slope and elevation of the site best suited to school garden work are identical with those given in a previous chapter relative to the kitchen garden. The fertility and texture of the soil chosen are of prime importance. Average land will require the addition of large

amounts of fertilizers and animal manures at the beginning of the work to make the project a successful one. Many discouragements for beginners are due to poor soil conditions, as it is not common knowledge that good garden land must possess a much larger amount of available plant food than is the case with farm crops.

FIG. 154.—One of the most valuable lines of practical laboratory work in agriculture is that of school gardening.

Planning.—If possible each member of the class should have a separate plot of land for the garden work. Each student then becomes responsible for a certain piece of work, which makes it much more satisfactory for both the student and the instructor. The size of each garden will depend upon the amount of time set aside for the work and the land and equipment available for this purpose. A plot about 20 x 40 feet is as large as can be properly cared for in three hours per week. A garden that is a little undersized is preferable to one that is too large to keep in a good condition in the allotted time.

After the size has been determined the class may be given an exercise in making a plan to scale on paper for the same, wherein each student plans the plot unaided as he

thinks it can be planted to best advantage. It is generally considered best, however, for all to follow the same plan when planting the garden. This is made by the instructor, perhaps with the aid of the class, and copies furnished each to follow as a guide in planting. This arrangement makes the gardens all well planned, uniform and gives opportunity for the one in charge to have continuous rows of each vegetable extending entirely across the plots.

Equipment.—The hand tools required for administering school garden work will be about as given in Chapter IV for the kitchen garden. It will not be necessary to have one for each student of the kinds listed with the possible exception of the hoe and rake. In addition to these, hot-bed materials, germinating apparatus and seed will be needed. Hauling manure for the hot-beds, fertilizing, plowing and harrowing are done with a team and the necessary farm tools.

HOT-BED.

Row No.	Vegetable.	Variety.	Date.			
			Planted.	Up.	Transplanted.	Set out.

GARDEN.

Row No.	Vegetable.	Variety.	Date.			Date harvested.		Total weight.	Value.
			Planted.	Up.	Thinned.	First.	Last.		

LABOR.

Date.	Kind.	Amount.	Cost.

Records.—In order to become familiar with the cultural requirements and the habit of growth of vegetable plants it is desirable to take notes as the work progresses. An account of the weather conditions, labor, etc., will also be valuable. These may be kept in tabular form as indicated on page 341.

Under the first column headed "Row No." in the first two forms given is placed the number of the row in which the vegetable is grown which means that each row on the paper plan of the hot-bed and garden must be given a number. Under the next to the last column in the second form is placed the total weight of each variety of vegetable harvested during the season. With vegetables like radishes and green onions it is also desirable to include the number of bunches of each. The value is determined by consulting the local markets.

Laboratory Exercises.—The number and character of the exercises to be given in a course in gardening depend largely upon local conditions such as available land and equipment, amount of time to be given to the work and age of the students concerned. The following outline gives an idea of what may be accomplished in three hours per week for a period of about eighteen weeks. Weather conditions may vary the dates given for outside work.

Week ending:

February 12. Make an original planting plan for the school garden plot.

February 19. Prepare an order for seed necessary for planting the garden as previously planned.

February 26. Make hot-bed and repair hot-bed sash.

March 4. Test vegetable seed and sow celery.

March 11. Sow early cauliflower, cabbage, head lettuce, tomatoes, egg plant and peppers in hot-bed. Count germination of seed.

March 18. Make a planting plan for a home vegetable garden to supply a family of five people. (Refer to bulletins.)

March 25. Prick off seedlings of cabbage, cauliflower and head lettuce. Complete seed germination count.

April 1. Copy planting plan of student gardens and prepare data sheet for the same. Prick off seedlings of

celery, tomato, egg plant and pepper. Treat seed potatoes with formalin for scab.

April 8. Plant first cool season crops: Radishes, leaf lettuce, spinach, onion sets, peas and potatoes.

April 15. Plant remainder of cool season vegetables: Beets, turnips, chard, onion seed, parsnips, carrots, parsley, salsify and kohlrabi. Transplant to garden: Cabbage, cauliflower and head lettuce.

April 22. Bed sweet potatoes in hot-bed. Shift tomatoes, egg plants and peppers in hot-bed to four-inch pots. Cultivate entire garden. Study seedlings.

April 29. Plant string beans. Thin leaf lettuce and spinach. Cultivate garden.

May 6. Plant corn, cucumbers and squash. Transplant tomatoes to the garden. Thin turnips, beets, chard, salsify and kohlrabi. Cultivate garden.

May 13. Transplant peppers and egg plant to the garden. Thin parsnips, carrots, parsley and onions. Spray or dust cucumbers and squash. Harvest and prepare for market: Radishes, green onions and spinach. Cultivate garden.

May 20. Transplant celery and sweet potatoes to the garden. Harvest and prepare for market: Leaf lettuce, turnips and spinach. Cultivate garden.

May 27. Spray or dust cucumbers and squash. Stake tomatoes. Cultivate garden.

June 3. Harvest and prepare for market: Head lettuce and kohlrabi.

NOTE: In case the soil is too wet or the weather too inclement to work at any laboratory period each student may be assigned a bulletin dealing with some phase of vegetable growing to read and write an abstract upon.

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